NPL LISTING PACKAGE

FOR THE

LOWER DARBY CREEK AREA

DELAWARE AND PHILADELPHIA COUNTIES, PENNSYLVANIA

June 2001

U.S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103

1.0 INTRODUCTION

Contained within this listing package are two complete documentation records for two separate sites. These sites are being grouped into a single listing consistent with CERCLA 105(a)(8)(B). The sections below present general information about the listing, the location of the sites, operations at the sites, the environmental conditions of Lower Darby Creek, other potentials sources of contamination to Lower Darby Creek and the geology of the area.

General Information

The Lower Darby Creek Area (LDCA) site as originally proposed consisted of multiple sources releasing or potentially releasing into the waters of Darby Creek and other nearby streams: the Clearview Landfill (Source 1), the Industrial Drive properties (Source 2), the Oily Sludge Disposal Area (Source 3), the Catalyst Disposal Area (Source 4), the former Delaware County Sewage Treatment Plant (Source 5), the former Delaware County Incinerator (Source 6), and the Folcroft Landfill and Annex (Source 7). After considering the public comments received for the LDCA (see the *Support Document for the Revised National Priorities List Final Rule-June 14, 2001* for the public comments received), EPA decided to promulgate the LDCA as a grouping of two separate sites, the Clearview Landfill site and the Folcroft Landfill and Annex site, for administrative purposes. The single NPL listing facilitates the management of the investigation and cleanup of the releases to Darby Creek, which have affected or might affect the same portion of the creek, which includes fisheries, wetlands, and other sensitive environments, including the John Heinz National Wildlife Refuge (NWR) at Tinicum. Contained within this listing package are two separate documentation records demonstrating that each of these sites qualifies independently for the NPL.

Both of these sites consist of releases of hazardous substances into the waters of Darby Creek. Hazardous substances of concern associated with both of these sites include heavy metals, polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), and polychlorinated biphenyls (PCBs). The release of these substances into Darby Creek poses a threat to people who might consume fish from the creek, as well as an ecological threat to wetland areas and other sensitive environments.

The two sites are located in an industrialized portion of southeastern Delaware County and southwestern Philadelphia County, Pennsylvania. The Clearview Landfill site is located just downstream of the junction of Cobbs Creek and Darby Creek, in Delaware and Philadelphia Counties. The Folcroft Landfill and Annex is located in the tidal marsh of John Heinz NWR at Tinicum, in Delaware County(Ref. 31, pp. 1, 2, and 3). Darby Creek generally flows from north to south and discharges to the Delaware River a few miles downstream (Ref. 34) (see Figure 1).

Site Operations

The Clearview Landfill operated without a permit from the late 1950s until approximately 1973 and was used for the disposal of municipal wastes generated by the City of Philadelphia and portions of Delaware County (Ref. 31, pp. 14 to 16; Ref. 5, p. 1). Because of several violations of state regulations, and the absence of a permit, the Pennsylvania Department of Environmental Resources (PADER) took court action under which the landfill was closed in August 1973 (Ref. 31, p. 16).

The Folcroft Landfill and Annex, located on the John Heinz NWR, was permitted from approximately 1959 until 1974 to accept municipal, demolition, and hospital wastes. However, analysis of aerial photographs indicates that disposal activity took place as early as 1953 and that, by 1958, the landfill covered approximately two acres. Inspection reports prepared by PADER indicate that numerous permit violations occurred during operations (Ref. 31, p. 4). See Figure 1 for locations of the Clearview Landfill and Folcroft Landfill and Annex.

Environmental Conditions of Lower Darby Creek – Additional Sampling Information – Darby, Cobbs, and Hermesprota Creeks

Various studies over the past 20 or more years have attempted to evaluate the environmental conditions of Lower Darby Creek. The following section summarizes the results of some of these studies.

1983 Site Investigation

On September 7, 1983, aqueous and sediment samples were collected from Hermesprota Creek. An "upstream Hermesprota Creek" sample, collected upstream of the Folcroft Landfill and Annex and south of Tribbett Road, was selected to reflect background conditions. In comparison to this background sample, downstream aqueous samples collected from two locations showed elevated concentrations of several metals. Similarly, downstream sediment samples from these two locations showed elevated concentrations of cyanide. The two downstream locations were "downstream Hermesprota Creek," located on the southwestern boundary of Folcroft Landfill and south of Folcroft Landfill Annex, and "ponded water," located at the base of Folcroft Annex in a wetland adjacent to Hermesprota Creek (Ref. 20, pp. 5-2, 6-1-4, 6-1-5; Appendix B, pp. B-3; and Appendix D, pp. D-25, D-26, D-27, D-28, D-33, and D-34).

1987-88 Site Inspection

In November 1987, EPA and Federal Wildlife Service (FWS) collected sediment (intertidal and subtidal) samples from Hermesprota, Darby, and Cobbs Creeks and from the John Heinz NWR impoundment. The Darby Creek sample locations ranged from upstream of Clearview Landfill to downstream of Folcroft Landfill. For the intertidal sediment samples, no comparable background samples were collected. For the subtidal sediments, which are submerged soils found on stream banks and bottoms below the low tide level, two of the nine locations were considered representative of background: DAR-5 in Darby Creek and HER-2 in Hermesprota Creek. In comparison to these background samples, some of the downstream samples contained significantly increased levels of some metals and/or PAHs, most notably sample HER-1 (Hermesprota Creek downstream of Folcroft Landfill and Annex) with elevated metals (Ref. 24, p. I-1, III-18, -25, -29, -30; Tables III-10, III-11, and B-1; Figure III-4 and p. III-23, Figure III-6).

On April 28 and 29, 1988, EPA and FWS collected surface water samples during falling tides from the same nine locations from which samples of subtidal sediment were collected; two leachate seep samples were also collected. In comparison to background samples, several of the downstream samples contained elevated levels of aluminum and/or barium (Ref. 24, p. III-36, -42, App. B, Table B-1).

1998 Site Inspection

In May 1998, surface water samples were collected from Lower Darby Creek to determine whether Clearview Landfill, Folcroft Landfill and Annex, and several properties in between were impacting John Heinz NWR and surface water bodies within the Darby Creek watershed (Ref. 31, p. 1). Sediment samples were collected from the Darby Creek watershed from upstream of Clearview Landfill (background locations) to about two miles downstream of Folcroft Landfill and Annex (Ref. 31, pp. 18 to 25).

Background samples were collected upstream from both Folcroft Landfill and Annex and Clearview Landfill. Background locations in Darby, Cobbs, and Hermesprota Creeks included samples DAR/SW02 & SD02, DAR/SW03 & SD03, COB/SW04 & SD04, and HER/SW31 & SD31 (Ref. 31, pp. 17, 19, 21, Table SW-11) (see Figure 5). In comparison to these background samples, some of the downstream samples from Darby and Hermesprota Creeks contained significantly increased levels of various substances, particularly metals. (Ref. 31, pp. 17- 25 and Figure 7; Ref. 83, Appendix B, pp. 1-12, 22; Appendix C, SDG MCSD00, pp. 2, 6, 8, 10-12; SDG MSCD37, pp. 2-3; SDG MCSC48, p. 4, 10, 14; SDG MCSD01, pp. 5, 6, 9, 10, 17; SDG MCSD28, p. 2; SDG MCSC74, p. 5; SDG MCSC56, pp. 2, 6; Appendix D, pp. 2-14; Ref. 85, Appendix B, pp. 21, 43- 45).

Other Potential Sources of Contamination to Lower Darby Creek Not Evaluated

Several other potential sources of contamination to Darby Creek and the John Heinz NWR have been identified but are not evaluated within this HRS documentation record. Nine of these sources are discussed briefly here, in order from most upstream (north/east) to most downstream (south/west) along Darby Creek.

Industrial Drive Properties:

[Note: This source was evaluated as “Source 2" in the proposed HRS Documentation Record (5/11/00).]

Industrial Drive is a short street that runs south from Hook Road, slightly west of and parallel to Darby Creek. It is located in Darby Township, Delaware County (Ref. 31, p. 14). Aerial photographs identify these properties as an open dump in the early 1950s (Ref. 37, pp. 2 and 8). The area was later utilized for various commercial and industrial purposes (Ref. 37, pp. 8 through 19). Currently, several salvage yards and a vehicle repair garage occupy the area (Ref. 31, p. 14). As of February 2000, the Industrial Drive Properties included the following businesses: Atlas Recycling, American Sheet Metal, Lombardo Scrapyard/Fairview Hauling, Ray’s Truck Parts, Gricco’s Garage, Bruce’s Auto Body, Salerno Tire, and Bell Atlantic Mobile (cellular telephone tower) (Ref. 90, p. 1).

Several sampling events have documented the presence of elevated levels of several metals (e.g., lead at 1580 mg/kg) and PAHs (Ref.31, pp. 18, 20, Table 5a, Table 5c, 9-B-36, 9-B-39; Ref 90, Table 1, pp. 5 and 6; Table 3, pp. 12 and 13; Table 9, p. 22; Figure 3, p. 8; App. F, pp. F-16, 50, 53, 56, 59, 62, 65, 68, 133, 142 through 146, 158, and 167).

Oily Sludge Disposal Area (Sun Oil Darby Creek Tank Farm):

[Note: This source was evaluated as “Source 3" in the proposed HRS Documentation Record (5/11/00).]

The Sun Oil Company purchased the Chevron Corporation Refinery in 1994, including the Darby Creek Tank Farm (Ref. 3). The Oily Sludge Disposal Area is located in the eastern portion of the tank farm. The area used for disposal was an excavation remaining from a former gravel quarry. It was used primarily for the disposal of oily dirt generated from the former Gulf Oil Refinery (located on the east bank of the Schuykill River), as well as various refinery catalysts. Scrap metal, such as refrigerators, reportedly also were landfilled there (Ref. 73, p. 2; Ref. 75, p. 1; Ref. 74, p. 2-5).

Samples have documented elevated levels of metals and PAHs (Ref. 74, Table 5-3, p. 5-3; pp. 7-9e, 7-9g, 7-9k).

Catalyst Disposal Area (Sun Oil Darby Creek Tank Farm):

[Note: This source was evaluated as “Source 4" in the proposed HRS Documentation Record (5/11/00).]

The Catalyst Disposal Area is located in the central portion of the tank farm along the western boundary, approximately 135 feet west of Darby Creek (Ref. 75, p. 21 and Figure 4). It was a basin or pond that was filled primarily with catalysts contaminated with acid, also from the former Gulf Oil Refinery (Ref. 74, pp. 2-5 and 4-1; Ref. 72, pp. 2 and 9; Ref. 73, p. 1).

Samples collected from this area contained elevated levels of arsenic, mercury, and PAHs (Ref. 74, Table 5-3, pl 5-3; Ref. 35; 74, Table 5-3, p. 5-3; pp. 7-9e, 7-9g, 7-9k).

Neutralized Hydrofluoric-Acid Trash Disposal Area (Sun Oil Darby Creek Tank Farm):

The Neutralized Hydrofluoric-Acid Trash Disposal Area is located in the south central portion of the tank farm. The waste was generated from the former Gulf Oil Refinery from a process that used acid. The contaminated waste was neutralized with caustic soda prior to disposal (Ref. 74, p. 4-1 and Figure 2-2, p. 2-3; Ref. 73, pp. 1, 2, and 14).

Sewage Sludge Disposal Area (former Darby Creek Joint Authority Sewage Treatment Plant):
[Note: This source was evaluated as “Source 5" in the proposed HRS Documentation Record (5/11/00).]

The Sewage Sludge Disposal Area is located at the former Darby Creek Joint Authority Sewage Treatment Plant, in Darby Township, Delaware County (Ref. 31, p. 9 and Figures 1 and 5). The plant discharged directly to Darby Creek (Ref. 31, p. 9). Aerial photographs show sewage sludge disposal activity being carried out in 1958 in a wetland area to the south of the treatment plant (Ref. 37, pp. 24 to 25). According to a representative of the Delaware County Sewage Treatment Plant, sewage sludge was taken from the drying beds and disposed of in an area adjacent to the drying beds on the southern section of the property toward Route 291, the sewage sludge disposal area. The sewage sludge never was removed and probably has become overgrown with vegetation. When the sewage sludge drying beds (concrete structures) were closed, the sewage sludge was disposed of off site (Ref. 86). The former Delaware County Sewage Treatment Plant is currently used only as a pumping station, and the settling tanks and lagoons have been closed and partially filled in (Ref. 31, p. 9).

Several sampling events have demonstrated the presence of elevated levels of several metals and PAHs, as well as the PCB mix Aroclor 1260 (Ref. 90, Table 1, pp.5 and 6; Figure 3, p. 8; Figure 4, p. 9; Table 3,

pp. 12 and 13; Table 4, pp. 14 and 15; Table 6, p. 18; Table 7, p. 20; Table 10, p. 23; Figure 4, p. 9; and Appendix F, pp. F-79, F-80, F-126, and F-171; Table 9, p. 22; App. F, pp. 83, 86, 89, 92, 127, 129, 158, 167, 172, and 173).

Transformer Storage Area (former Darby Creek Joint Authority Sewage Treatment Plant):

The Transformer Storage Area is also located at the Darby Creek Joint Authority Sewage Treatment Plant. The source was identified during a February 2000 sampling investigation. A soil sample (STP-SD-4) collected from the area of the transformer contained 1,400 µg/kg of Aroclor 1260 (Ref. 90, Table 1, p. 6, Appendix F, p. F-126, and Figure 4, p. 9).

Delaware County Incinerator Landfill (former Delaware County Incinerator #2):

[Note: This source was evaluated as "Source 6" in the proposed HRS Documentation Record (5/11/00).]

The Delaware County Incinerator Landfill covers approximately 15 acres and was used for the disposal of ash and residue generated from the incinerator between the mid-1960s and 1971. The incinerator was owned and operated by Delaware County and reportedly handled approximately 500 to 800 tons of refuse per day (Ref. 31, pp. 6-7; 32, p. 2). Before the disposal activities took place, portions of the property were wetland or marsh areas (Ref. 31, p. 6; Ref. 32, p. 2). The landfill is bordered on the west by Hermesprota Creek (Ref. 31, pp. 7-8; Ref. 32, p. 2).

Observations made during the EPA 1998 sampling event indicated that the landfill area was being covered with additional soil in preparation for development of a canine training area. The former incinerator stack was demolished. The Delaware County Emergency Services Training Center currently uses the property (Ref. 31, pp. 7-9).

EPA collected six subsurface soil samples from the source during the 1998 sampling event. Three of the samples were analyzed for dioxin and were found to contain low levels of this substance. In comparison to a background soil sample (DAR/SS-01,01A), one of the six Delaware County Incinerator Landfill samples contained an elevated level of copper (Ref. 31, pp. 17, 18, 21-22, Attachment 9D, Dioxin Data Validation, Appendix B, p. 2; Ref. 83, Appendix B, p. 10, Appendix C, SDG MCSD28, pp. 4, 6, and 9).

Norwood Landfill:

The Norwood Landfill is located along the southwest edge of the John Heinz NWR in Norwood, Pennsylvania, southwest of the LDCA site. The U.S. Fish and Wildlife Service (FWS), U.S. Department of the Interior (DOI), is considering the purchase of the property on which the Norwood Landfill is located. According to available reports this area was used during the 1960s by the Borough of Norwood as a municipal landfill. A survey completed on the property in 1993 reported debris scattered across the property that included large amounts of glass; automobile frames and parts; aluminum siding; asphalt; concrete; and tires. It has also been reported that dredge material was disposed of on the property after the municipality ceased landfill activities (Ref. 77, p. 1-1). Analytical results of soil samples collected from the property in 1999 identified elevated levels of polyaromatic hydrocarbons (PAHs) and metals (Ref. 77, pp. 3-3 through 3-8). The property is currently heavily vegetated (Ref. 77, p.1-1). Darby Creek is located along the property's southeastern border (Ref. 77, p. 2-1a).

Boeing Defense and Space Group Area:

The Boeing Defense and Space Group property is located in Ridley Park, Pennsylvania, near the confluence of Darby Creek and the Delaware River, southwest of the LDCA site (Ref. 48, pp. 3 and 4). The Boeing Defense and Space Group property covers 350 acres and is divided into three contiguous areas, known as Center South, Center North, and the 63-Acre Site (Ref. 87, p. 2). From 1880 until 1956, the property was occupied by Baldwin Locomotives. Baldwin manufactured steam and diesel locomotives. Upon cessation of operations in 1956, most of the structures were demolished, leaving the foundations, which are still visible. The property is currently vacant and overgrown. Crum Creek, a tributary of the Delaware River, winds through the center of the property. In 1987, Boeing Helicopters acquired the property (Ref. 48, p. 3). Soil samples from the property revealed total petroleum hydrocarbons (TPH).

Ground water analytical results revealed significant concentrations of TPH, trichloroethylene (TCE), and acetone (Ref. 48, pp. 24, 25, and 26). Ground water contamination has also been identified under the Center North section of the Boeing Defense and Space Group property. Ground water was found to be contaminated with volatile organic compounds (VOCs) and TCE in both overburden and bedrock aquifers. A ground water extraction and treatment system was installed to treat the contaminated ground water (Ref. 87, p. 2).

The Boeing Defense and Space Group also holds a National Pollution Discharge Elimination System (NPDES) permit to discharge treated process wastewater from a wastewater treatment plant to Crum Creek, Darby Creek, and the Delaware River (Ref. 88, p. 1; Ref. 6, Figure 3-2).

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87.	McLaren/Hart Environmental Engineering Corporation. Erosion and Sediment Pollution Control Plan. Boeing Helicopters Center North, Ridley Township, Pennsylvania. May 1993. (Cover page and page 2 only). (2 pages).
88.	PADEP, Bureau of Water Quality Management. Internal Review and Recommendation. Boeing Helicopters, Ridley Township Delaware County. Application Number PA0013323. January 1996. (3 pages).
89.	Tetra Tech. Record of Telephone Conversation Regarding Number of Visitors to John Heinz National Wildlife Refuge. From Alicia Shultz, Project Manager. To Dick Nugent, Refuge Manager, John Heinz National Wildlife Refuge. February 10, 2000. (1 page).
90.	Tetra Tech. Field Trip Report, Additional Limited Sampling, Lower Darby Creek Area Site, Darby Township, Philadelphia and Delaware Counties, Pennsylvania. April 10, 2000. (347 pages).
91.	Roy F. Weston. Trip Report. 80th and Mars Place Site, Philadelphia, Philadelphia County, Pennsylvania. March 15, 2000. (165 pages).

FINAL
HRS DOCUMENTATION RECORD

Site Name:	Lower Darby Creek Area/Clearview Landfill
Contact Persons	
Site Contact:	Kristine Matzko, Remedial Project Manager U.S. Environmental Protection Agency (EPA) Region 3 (215) 814-5719
Documentation Record Contact:	Kevin Wood, NPL/HRS Coordinator EPA Region 3 (215) 814-3303

Pathways, Components, or Threats Not Scored

The Hazard Ranking System (HRS) evaluation performed for the Lower Darby Creek Area is focused exclusively on the surface water migration pathway. The ground water migration, soil exposure, and air migration pathways were not evaluated because their contribution to the overall score of the site is minimal.

FINAL
HRS DOCUMENTATION RECORD

Site Name: Lower Darby Creek Area/Clearview Landfill

EPA Region: 3

Date Prepared:**January 3, 2000**
Revision I: **April 24, 2000**
Final:**April 16, 2001**

Street Address of Site: 83rd Street and Buist Avenue

County and State: Delaware and Philadelphia Counties, Pennsylvania

General Location in the State: Southeastern Pennsylvania (Figure 1)

Topographic Maps: U.S. Geologic Survey (USGS), Bridgeport, NJ-PA and Lansdowne, PA, 1967

Latitude: 39° 54′ 09″ N (Ref. 78)* Longitude: 75° 15′ 15″ W (Ref. 78)*

*The reference point is above the second "A" in *Delaware County*, and at the end of the road in the Clearview Landfill (see Reference 78).

WORKSHEET FOR COMPUTING HRS SITE SCORE

		S	S^2
1.	Ground Water Migration Pathway Score (S_{gw}) (from HRS Table 3-1, Line 13)	NS[a]	NS
2a.	Surface Water Overland/Flood Migration Component (from HRS Table 4-1, Line 30)	96.06	9,227.52
2b.	Ground Water to Surface Water Migration Component (from HRS Table 4-25, Line 28)	NS	NS
2c.	Surface Water Migration Pathway Score (S_{sw}) (Enter the larger of the two scores from Lines 2a and 2b as the pathway score).	96.06	9,227.52
3.	Soil Exposure Pathway Score (S_s) (from HRS Table 5-1, Line 22)	NS	NS
4.	Air Migration Pathway Score (S_a) (from HRS Table 6-1, Line 12)	NS	NS
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$		9,227.52
6.	**HRS Site Score** Divide the value on Line 5 by 4 and take the square root		48.03

Note:

[a] NS = Not scored

LOWER DARBY CREEK AREA/CLEARVIEW LANDFILL
SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET

Factor Categories and Factors		Maximum Value	Value Assigned
Drinking Water Threat			
Likelihood of Release			
1. Observed Release		550	550
2. Potential to Release by Overland Flow			
2a. Containment	10		NS
2b. Runoff		25	NS
2c. Distance to Surface Water		25	NS
2d. Potential to Release by Overland Flow [lines 2a x (2b +2c)]		500	NS
3. Potential to Release by Flood			
3a. Containment (Flood)	10		NS
3b. Flood Frequency		50	NS
3c. Potential to Release by Flood [lines 3a x 3b]		500	NS
4. Potential to Release [lines 2d + 3c]		500	NS
5. Likelihood of Release [higher of lines 1 and 4]		550	NS
Waste Characteristics			
6. Toxicity/Persistence		a	NS
7. Hazardous Waste Quantity		a	NS
8. Waste Characteristics		100	NS
Targets			
9. Nearest Intake		50	NS
10. Population			
10a. Level I Concentrations		b	NS
10b. Level II Concentrations		b	NS
10c. Potential Contamination		b	NS
10d. Population [lines 10a + 10b + 10c]		b	NS
11. Resources		5	NS
12. Targets [lines 9 + 10d + 11]		b	NS
Drinking Water Threat Score			
13. Drinking Water Threat Score [lines 5 x 8 x 12)/82,500][c]		100	NS

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer
NS Not scored

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET (Cont.)

Factor Categories and Factors	Maximum Value	Value Assigned
Human Food Chain Threat		
Likelihood of Release		
14. Likelihood of Release [same value as line 5]	550	550
Waste Characteristics		
15. Toxicity/Persistence/Bioaccumulation	a	5×10^8
16. Hazardous Waste Quantity	a	100
17. Waste Characteristics	1,000	320
Targets		
18. Food Chain Individual	50	45
19. Population		
19a. Level I Concentrations	b	0
19b. Level II Concentrations	b	0.03
19c. Potential Contamination	b	NS
19d. Population [lines 19a + 19b + 19c]	b	0.03
20. Targets [lines 18 + 19d]	b	45.03
Human Food Chain Threat Score		
21. Human Food Chain Threat Score [lines 14 x 17 x 20)/82,500][c]	100	96.06

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer
NS Not Scored

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET (Cont.)

Factor Categories and Factors	Maximum Value	Value Assigned
Environmental Threat		
Likelihood of Release		
22. Likelihood of Release [same value as line 5]	550	550
Waste Characteristics		
23. Ecosystem Toxicity/Persistence/Bioaccumulation	a	NS
24. Hazardous Waste Quantity	a	NS
25. Waste Characteristics	1,000	NS
Targets		
26. Sensitive Environments		
26a. Level I Concentrations	b	NS
26b. Level II Concentrations	b	NS
26c. Potential Contamination	b	NS
27. Targets [lines 26a + 26b + 26c]	b	NS
Environmental Threat Score		
28. Environmental Threat Score [lines 22 x 25 x 27)/82,500][c]	60	NS
Surface Water Overland/Flood Migration Component Score for a Watershed		
29. Watershed Score [lines 13 + 21 + 28][c]	100	96.06
SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE		
30. Component Score (S_{of})[c] [highest score from line 29 for all watersheds evaluated][c]	100	96.06

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer
NS Not scored

1.0 INTRODUCTION

The site is composed of one source, the Clearview Landfill, and the releases from it. The Clearview Landfill is located on the lower Darby Creek. Darby Creek is considered a fishery at the Clearview Landfill and for the entire TDL for the site. There is a release by direct observation from the landfill. Metals, PCBs, PAHs and VOCs are some of the hazardous substances that have been associated with the Clearview Landfill. The Clearview Landfill operated without a permit from the late 1950s until approximately 1973 and was used for the disposal of municipal wastes generated by the City of Philadelphia and portions of Delaware County (Ref. 31, pp. 14 to 16; Ref. 5, p. 1). Because of several violations of state regulations, and the absence of a permit, the PADER took court action under which the landfill was closed in August 1973 (Ref. 31, p. 16). See Figure 1.

SOURCE DESCRIPTION

2.2 Source Characterization

HRS Source Type: Landfill

Source Description: Clearview Landfill

The Clearview Landfill is located along the eastern bank of Darby and Cobbs Creeks, at 83rd Street and Buist Avenue (Figure 1). It is located partially in Darby Township, Delaware County and partially in Philadelphia County, Pennsylvania (Ref. 5, p.1). Aerial photographs indicate that the landfill was as large as 65 acres (Ref. 4, p. 16). According to reports, the landfill was located on a 50-acre parcel of land that the Clearview Land Development Corporation owned since the late 1950s. An unpermitted municipal waste landfill has operated at the location since the late 1950s. D. Richard Heller is the owner of Clearview Land Development Corporation (Ref. 5, p.1). The owners failed to meet the provisions of an interim consent order issued in November 1971; therefore, the State issued a petition for contempt of the interim consent order in January 1973 (Ref. 5, p. 1). The property was used to dispose of municipal wastes from the City of Philadelphia and portions of Delaware County. In December 1970, the state filed an injunction against the landfill for operating without a permit (Ref. 5, p. 1). In February 1973, a judge ordered Clearview Land Development Corporation to submit a final closure plan. On September 30, 1973, a final order was issued under which all disposal activities at the landfill were to cease and the Clearview Land Development Company was to follow a prescribed closure plan (Ref. 5, p. 1). In 1976, the Philadelphia Redevelopment authority covered and seeded a portion of the landfill. Between 1976 and 1977, hundreds of residences were constructed around the eastern and southern borders of the landfill (Ref. 5, p.2).

The U.S. Environmental Protection Agency's (EPA) Environmental Photographic Interpretation Center, Environmental Monitoring Systems Laboratory completed an analysis of the Clearview Landfill in 1984 (Ref. 4, p. *i*). The 1953 aerial photograph of Clearview Landfill shows a 3.3-acre area of debris and mounded earthen material located north and south of an access road leading into the property from Buist Avenue. The photograph shows that the property was situated on and surrounded by wetlands and a stream flows through the landfill along the eastern boundary (Ref. 4, pp. 6, 7, and 8). Aerial photographs from 1958 to 1973 show that these wetlands and the stream become landfilled (Ref. 4, pp. 6, 7 ,8, 9, 10, 11, 13, 14, 15, 16, and 17).

In 1973, the landfill expanded to 65 acres (Ref. 4, pp. 16, and 17). Pools of standing liquid and pits containing liquid were observed on the landfill surface in several of the aerial photographs (Ref. 4, pp. 10, 11, 12, 13, 18, 19, and 20). The constituents of the liquid were not been determined. The aerial photographs indicated that large quantities of liquid were disposed of in the landfill. Dark stains were also observed on the landfill (Ref. 4, pp. 18, 19, and 20). Tank cars and tanks were observed on the landfill indicating that liquid wastes may have been brought to the landfill (Ref. 4, pp. 18 and 19).

The 1973 aerial photograph shows the presence of new residences constructed east of the landfill (Ref. 4, pp. 16 and 17). A recreation area is under construction at the northeast corner of the landfill in the April 1979 aerial photograph (Ref. 4, p. 20). The June 1983 aerial photograph shows new residences constructed at the southeast corner of the landfill, possibly on top of a former fill area that had been visible in the aerial photograph taken in 1953 (Ref. 4, pp. 6, 7, 22, and 23).

On June 12, 1980, Pennsylvania Department of Environmental Protection (PADEP) conducted an investigation of the reported dumping and open burning of waste materials at the Clearview Landfill. The investigation found that waste material, including demolition wastes, tires, furniture, household appliances, and bedding, had been deposited at the top and on the southwest face of the landfill, and that an area on the east bank of Cobbs Creek was being filled in with material consisting of significant quantities of lumber, rugs, and other materials that were not "clean fill" materials. A notice of violation (NOV) was issued to D. Richard Heller of Clearview Land Development (Ref. 64).

On November 25, 1981, PADEP conducted an inspection of Clearview Landfill and nearby areas. During the inspection, the following conditions were noted at the landfill: a dump area between 84th Street and the owner's office building consisting of a large quantity of demolition debris, bulky items, old car parts, and trash; a dump area between 84th Street and the foot of the landfill, consisting of a large amount of demolition debris, old tires, concrete, and trash; and several areas on top of the landfill, consisting of at least 15 cubic yards of granular insulation, at least 10 cubic yards of a black ash, and several piles of demolition debris in the area of the owner's office. In addition, large storage containers owned by Graves Resource Management (GRM) (an unpermitted transfer, storage, and disposal facility for hazardous waste that operated between 1980 and 1981 and was located south of the landfill) were present. Those conditions were in direct violation of an August 7, 1973 court-ordered closure of the landfill, a PADEP order to close the GRM facility, the Pennsylvania Solid Waste Management Act (PA SWMA), and several sections of PADEP's rules and regulations. Therefore, PADEP issued another NOV to Mr. Heller (Ref. 19).

On December 17, 1982, PADEP conducted an inspection of Clearview Landfill and noted that waste materials had been deposited directly on the ground. The waste material included demolition debris, abandoned automobiles and automobile parts, and scrap metal. PADEP notified Clearview Landfill of those violations of the PA SWMA and several sections of PADEP's rules and regulations. Therefore, PADEP issued a third NOV to Mr. Heller (Ref. 65).

On May 16, 1984; December 8, 1986; and October 27, 1987; PADEP sent Mr. Heller additional NOVs for numerous violations of the PA SWMA (Ref. 69, p. 4).

On September 27, 1982, Robert Zang of PADEP conducted an SI of the landfill. In his SI report, Mr. Zang stated that the landfill is more than 100 acres in size (Ref. 9, p. 3). He stated further that a leachate pond was present on the landfill near Darby Creek and that a foul odor was present when he walked through the stream to conduct sampling (Ref. 9, p. 6).

EPA Region 3's Field Investigation Team (FIT3) completed SIs at the landfill. On October 6, 1983 and August 6 and October 1, 1984, surface water, sediment, soil, and leachate samples were collected from the landfill and Darby Creek (Ref. 12, p. 5-1; Ref. 13, pp. 1 and 2). Polychlorinated biphenyls (PCBs) and polyaromatic hydrocarbons (PAHs) were revealed in leachate, PAHs were detected in soil, and PCBs were detected in stream and soil samples (Ref. 5, p. 2; Ref. 12, p. 6-3; Ref. 13, pp. 2 and 5). On September 25, 1990, the FIT3 observed areas of recent dumping throughout the landfill and three leachate seeps on the western edge that were draining into Darby Creek. VOCs, semivolatile organic compounds (SVOC), and PAHs were detected in the leachate seeps and downstream sediments (Ref. 5, p. 3).

Illegal disposal of waste at the landfill has continued at least through 1998. According to the PADEP complaint of equity against D. Richard Heller, evidence of waste deposition was observed at the landfill throughout 1997 and 1998 (Ref. 69, pp. 1, 4 through 8).

In May 1998, EPA sampled the landfill as part of a comprehensive sampling effort in the area of Darby Creek. Soils and waste source samples collected from the landfill contained elevated levels of metals, PAHs, and PCBs (Ref. 31, p. 28). The locations of the samples are shown on Figure 2.

In April 1999 an emergency response was conducted at a site called the 80th and Mars Place site (Ref. 91, p. 1). A review of the aerial photographs from the Clearview Landfill and the location of that site indicates that the site may be part of the Clearview Landfill (Ref. 91, p. 1 and Figure 2, p. 2; Ref. 4). Three surface soil samples were collected from the site. According to the trip report, significant concentrations of the following hazardous substances were detected in the soil samples: benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, Aroclor-1260, aluminum, arsenic, cadmium, manganese, and vanadium (Ref. 91, pp. 4 and 5 and Attachment 1).

In addition to the unpermitted landfilling activities described above, the property historically was used for other waste disposal operations. In 1973, PADEP granted ROMA Associates, Incorporated, a permit to construct and operate a batch asphalt plant south of the landfill. The asphalt plant operated from 1973 until 1976 (Ref. 5, p. 2). GRM operated a hazardous waste treatment, storage, and disposal facility (TSDF) at the Clearview Landfill (Ref. 18 and Ref. 38). A PADEP order dated November 19, 1981 found that the company continued to operate the TSDF in violation of Section 403 of the SWMA (Ref. 18, p. 1). In the order, numerous violations are cited, including acceptance of wastes from unlicensed haulers; failures to maintain the facility so as to minimize the possibility of release of waste to the environment; and the presence of containers at the facility that are not closed during storage and not managed to prevent leaks and spills of waste (Ref. 18, p. 2). Because of the numerous violations, the facility's interim status was revoked (Ref. 18, p. 3). The owner of the operation was Albert F. Ingram (Ref. 8). In 1984, Mr. Ingram was sentenced to a prison term for two counts of transporting and dumping hazardous wastes committed in 1982 (Ref. 8).

In the late 1980s three other companies operated by Mr. Heller were located at the same location as the landfill. Those companies were DeLorenzo Twin County Disposal, Bizarro Corporation, and Eagleville Excavating (Ref. 5, p. 2). In October 1982, DeLorenzo applied for a permit to operate a solid waste transfer station (Ref. 14).

Figure 2, Clearview Landfill 1998 Sampling Locations.

In addition to the detection of hazardous substances in soil and leachate samples collected at the site, testimony from former employees documented the disposal of hazardous substances at the Clearview Landfill. In 1984, a former employee of the Clearview Landfill testified in court that he had helped bury poisonous chemicals at the landfill while he was employed there from 1966 to 1973. The former employee stated that he frequently had worked with chemicals at the landfill and would be ill for at least a day, particularly after he helped fight fires. The employee was testifying at a Worker's Compensation hearing in the case of his uncle, another employee of the landfill who had died of cancer in 1962. The wife of the deceased employee had filed a claim charging that toxic wastes at the Clearview Landfill were responsible for the death. Under examination during the court proceedings, the former employee, who had operated a bulldozer at the landfill, stated that the operator of the landfill would accept anything, including drums of poisonous wastes. He stated further that the landfill frequently took loads of drums from the Dupont Paint Company that sometimes were marked clearly to be poison. He stated that his late uncle often punctured the drums with the bulldozer blades and pushed the debris into a massive mound of trash. Other times they broke the drums and dumped them into a massive "paint pit" at the landfill. The pit has since been covered with dirt. The former employee stated that his uncle broke the drums because, if the men ran over the drums with a bulldozer, the drums would explode and the men would be doused with poisonous chemicals. The former employee once was hospitalized for more than a week for chemical burns after a barrel exploded and he was sprayed. Mr. Heller often called him in the middle of the night to fight fires because local firefighters refused to respond. The former employee stated that, after they fought the fires, he experienced a burning sensation in his throat and vomited for days. He stated that he was exposed to so many hazardous chemicals at the landfill and that his clothes pulled apart after light wear and he went through a pair of shoes in a month (Ref. 40).

Source Location:

Clearview Landfill is located along the eastern bank of Darby and Cobbs Creeks, at 83rd Street and Buist Avenue. It is located partially in Darby Township, Delaware County, and partially in Philadelphia County, Pennsylvania (Ref. 5, p.1 and Attachment 1) (Figures 1 and 2).

Containment:

Release to Groundwater: The ground water pathway was not evaluated.

Release via overland migration and/or flood: There is no documentation of a maintained engineered cover or functioning and maintained runon control system and runoff management system at Clearview Landfill; therefore, a containment factor of 10 is assigned (Ref. 1, p. 51609; Ref. 5, p. 4; Ref. 36, p. IV-9).

Gas Release to Air: The air migration pathway was not evaluated.

Particulate Release to Air: The air migration pathway was not evaluated.

2.4.1 Hazardous Substances

EPA has collected samples from the Clearview Landfill on four occasions. Hazardous substances have been detected in leachate flowing from the landfill, as well as in soil samples collected from the landfill, as summarized in Table 1.

SD-Characterization and Containment
Source: Clearview Landfill

Table 1
HAZARDOUS SUBSTANCES DETECTED AT CLEARVIEW LANDFILL
PAGE 1 OF 2

Sample ID		C4170		02	03	04	05	06	07	08	CCY79		CCY80/MCEC80		CCY83		CLF/SS09
Sample Date		10/6/83		1984	1984	1984	1984	1984	1984	1984	9/25/90		9/25/90		9/25/90		May 18 - 28, 1998
Reference		12, pp. 6-3, 7-43, 7-44		5, p. 18	5, p. 18	5, p. 18	5, p. 18	5, p. 18	5, p. 18	5, p. 18	5, pp. 25 and 30		5, pp. 25 and 30		5, pp. 25 and 30		31, Table 5-C, p. 2, 19, and 9-B-38,
Sample Location	CRDL	Leachate	Q	Junkyard Soil (6-12")	Junkyard Soil (12-18")	Soil Below Drum Area (6-12")	Soil Above Transfer Station (6-12")	Soil Along Access Road (6-12")	Soil Along Access Road Closest to Site	Soil Along Access Road Furthest From Site	LD1 - Leachate	Q	LD2 - Leachate	Q	LD5 - Leachate	Q	Landfill Surface Soil
SVOCs (µg/kg)																	
Anthracene	330				1000												
Benzo(a)anthracene	330	1400			1100	2000			1600		1200	J	1100	J	1000	J	690
Benzo(a)pyrene	330	1100				2100			1400		1200	J	1100	J	1000	J	670
Benzo(b)fluoranthene	330	970				2300			1400		1200	J	1100	J	1100	J	1100
Benzo(g,h,i)perylene	330										810	J	780	J	650	J	530
Benzo(k)fluoranthene	330				1800	1900			1600		1300	J	1000	J	1000	J	

Sample ID		C4170		02	03	04	05	06	07	08	CCY79		CCY80/MCEC80		CCY83		CLF/SS09
Sample Date		10/6/83		1984	1984	1984	1984	1984	1984	1984	9/25/90		9/25/90		9/25/90		May 18 - 28, 1998
Reference		12, pp. 6-3, 7-43, 7-44		5, p. 18	5, p. 18	5, p. 18	5, p. 18	5, p. 18	5, p. 18	5, p. 18	5, pp. 25 and 30		5, pp. 25 and 30		5, pp. 25 and 30		31, Table 5-C, p. 2, 19, and 9-B-38,
Sample Location	CRDL	Leachate	Q	Junkyard Soil (6-12")	Junkyard Soil (12-18")	Soil Below Drum Area (6-12")	Soil Above Transfer Station (6-12")	Soil Along Access Road (6-12")	Soil Along Access Road Closest to Site	Soil Along Access Road Furthest From Site	LD1 - Leachate	Q	LD2 - Leachate	Q	LD5 - Leachate	Q	Landfill Surface Soil
Chrysene	330	1300			1100	2100			1700		1500	J	1300	J	1200	J	750
Fluoranthene	330	2800		1100	3200	4500		1400	3700	1000	2500	J	2200	J	1800	J	
Indeno(1,2,3-cd)pyrene	330										750	J	740	J	680	J	540
Phenanthrene	330	1700		1000	3700	2900		1200	2500		2000	J	1900	J	1500	J	750
											Pyrene	330	3100		1200	2700	3900
Pesticides/PCBs (μg/kg)																	
Aroclor - 1248	33	370															

Aroclor - 1254	33																240
Aroclor - 1260	33	227					420	420	143,000	310							250 B
Chlordane (alpha)	1.7																4.1 J
Chlordane (gamma)	1.7																6.8 J
4,4 - DDD	3.3																12 J
4,4 - DDE	3.3																6.6 J
4,4 - DDT	3.3																8.4 J
Endrin aldehyde	3.3																13 J

Table 1
HAZARDOUS SUBSTANCES DETECTED AT CLEARVIEW LANDFILL
PAGE 2 OF 2

Sample ID		**CLF/SS07**		**CLF/SS07A**		**CLF/SS09**		**CLF/SS10**	
Sample Date		**May/June 1998**		**May/June 1998**		**May/June 1998**		**May/June 1998**	
Reference		**31, pp. 19, Table 5a, p. 1 of 3 and p. 9-a-4**		**31, p. 19, Table 5a, p. 1 of 3, and p. 9-a-9**		**31, pp. 19, Table 5a, p. 1 of 3 and p. 9-a-9**		**31, p. 20, Table 5a, p. 1 of 3 and p. 9-a-4**	
Sample Location	**CRDL**	**Debris Pile**	**Q**	**Duplicate of CLF/SS07**	**Q**	**Surface Soil, Clearview Landfill**	**Q**	**Debris Pile**	**Q**
Compounds (mg/kg)									
Antimony	12	3.6	L	3.7	L	8.5	L	7.3	L
Arsenic	2	5.8		6		12.9		7.5	

Sample ID		CLF/SS07		CLF/SS07A		CLF/SS09		CLF/SS10	
Sample Date		May/June 1998		May/June 1998		May/June 1998		May/June 1998	
Reference		31, pp. 19, Table 5a, p. 1 of 3 and p. 9-a-4		31, p. 19, Table 5a, p. 1 of 3, and p. 9-a-9		31, pp. 19, Table 5a, p. 1 of 3 and p. 9-a-9		31, p. 20, Table 5a, p. 1 of 3 and p. 9-a-4	
Sample Location	CRDL	Debris Pile	Q	Duplicate of CLF/SS07	Q	Surface Soil, Clearview Landfill	Q	Debris Pile	Q
Barium	40	287		233		264		173	
Cadmium	1	2.2		2.5		2.4		2.8	
Copper	5	102	J	110	J	442	J	297	J
Lead	0.6	538		563		849	B	468	
Mercury	0.1	0.51		0.5		0.56	L	0.38	
Nickel	8	21.7		24.1		61.2		41.7	
Selenium	1			131			UL		
Silver	2	6.1		7		2		2.9	
Zinc	4	412		397		1,500		1,260	

B Not detected significantly above the concentration detected in the laboratory blank.
CRDL Contract Required Detection Limit
J Estimated value. Actual value may be higher or lower; however, the presence is not in doubt.
L Analyte present. Reported value may be biased low. Actual value is expected to be higher.
mg/kg Milligram per kilogram
µg/kg Microgram per kilogram
Empty Cell indicates that the compound was not detected.
Sample SS08 was not included because it was collected as a reference sample near a playground (Ref. 31, p. 19).

2.4.2 Hazardous Waste Quantity

2.4.2.1.1 Hazardous Constituent Quantity

Information available is not sufficient to adequately support the evaluation of the hazardous constituent quantity for Clearview Landfill.

Sum (pounds): Unknown
Hazardous Constituent Quantity Value (C): NA

2.4.2.1.2 Hazardous Waste Stream Quantity

Information available is not sufficient to adequately support the evaluation of the hazardous waste stream for Clearview Landfill.

Sum (pounds): Unknown
Hazardous Waste Stream Quantity Value: NA

2.4.2.1.3 Volume

Information available is not sufficient to adequately support the evaluation of the volume for Clearview Landfill.

Dimension of source (yd^3 or gallons): Unknown
Volume Assigned Value: NA

2.4.2.1.4 Area

A PADEP inspector estimated the size of the landfill to be in excess of 100 acres during a 1982 SI (Ref. 9, p. 3). The March 1973 aerial photograph interpretation estimated the size of the landfill at 65 acres (Ref. 4, pp. 16 and 17). To calculate a conservative HWQ value, 65 acres is used for the area calculation. The area divisor for determining the HWQ value assigned to a landfill is 3,400 (Ref. 1, p. 57591). The calculation of the HWQ value on the basis of the area of Clearview Landfill is 65 acres x 43,560 ft^2/acre = 2,831,400 ft^2. The calculation of the HWQ value on the basis of the area of Clearview Landfill is 2,831,400/3,400 resulting in a value of 832.76

Area of source (ft^2): 2,831,400
Area Assigned Value: 832.76

2.4.2.1.5 Source Hazardous Waste Quantity Value

The source HWQ value for Clearview Landfill is the value for the area of the landfill.

Source Hazardous Waste Quantity Value: 832.76

4.0 Surface Water Migration Pathway

4.1 Overland/Flood Migration Component

4.1.1.1 Definition of Hazardous Substance Migration Pathway for Overland Flow/Flood Component

Surface waters associated with the surface water migration pathway for the Clearview Landfill include Darby Creek, Hermesprota Creek, and the Delaware River. (Ref. 36, Figure following p. III-1). The farthest upstream segment of the surface water pathway is located at the northern end of Clearview Landfill, where Cobbs Creek merges with Darby Creek. Surface water runoff from the Clearview Landfill drains to Darby Creek (Figure 3). Hermesprota Creek enters the study area from the north and ultimately discharges to Darby Creek in the John Heinz NWR (Ref. 34). Muckinipattis Creek flows south into Darby Creek, downstream of Hermesprota Creek at a point in the John Heinz NWR. After receiving discharge from the tributaries described above, Darby Creek empties into the Delaware River (Ref. 34; Ref. 5, p. 4; Ref. 20, p. 3-1) (Figure 3). The target distance limit (TDL) ends 15 miles downstream of the PPE for Clearview Landfill (Figure 3).

Darby Creek is tidally influenced upstream to the confluence of Darby Creek and Cobbs Creek (Ref. 24, p. II-5). Numerous private and public agencies have been contacted to determine more exactly the extent of tidal influence of Darby Creek; however, no data are available that document the extent of tidal carry in the creek. Therefore, the upstream TDL was not evaluated.

Figure 3, Locations of Site and Surface Water Migration Pathway.

The surface-water migration pathways for the Clearview Landfill are described below.

Clearview Landfill - Overland Flow and PPE Clvw

Surface water runoff from the Clearview Landfill is expected to enter Cobbs Creek or Darby Creek at any of the landfill boundaries along Darby Creek. No surface-water containment structures are located on the landfill (Ref. 36, p. IV-9). Tributaries of Cobbs Creek and Darby Creek, formerly located on the landfill, were filled from the landfill operation (Ref. 4). Figure 4 shows the probable point of entry (PPE) for Clearview Landfill. The 15-mile downstream TDL from Clearview Landfill is described below and can be measured on Reference 34.

TABLE 2
CLEARVIEW LANDFILL - TARGET DISTANCE LIMIT

Segment	Description	Length (feet)	Mile/Feet Marker
1	From the PPE for Cobbs Creek to the confluence with Darby Creek	1,000	0.2/1,000
2	From Darby Creek to the Delaware River	23,760	4.7/24,760
3	Remainder of the TDL in the Delaware River	54,440	15/79,200

Figure 4, PPE for the Clearview Landfill.

4.1.2.1 LIKELIHOOD OF RELEASE

The surface-water migration pathway is evaluated against the criteria for an observed release of hazardous substances by direct observation.

4.1.2.1.1 Observed Release

Observed releases to Darby Creek have been documented by direct observation. A discussion of the documentation that supports an observed release to Darby Creek is provided in the section below.

Direct Observation

Observed releases by direct observation to Darby Creek from the Clearview Landfill have been documented. Wastes disposed of in the Clearview Landfill were deposited directly into surface water. Leachate from the landfill was observed to flow directly to Darby Creek. The sections below document observed releases by direct observation from the Clearview Landfill.

Direct Observation - Clearview Landfill

The 1953 aerial photographs of the current location of the Clearview Landfill show the area to consist of wetlands with tributaries of Cobbs Creek and Darby Creek flowing through the landfill (Ref. 4, p. 6). The 1958 aerial photograph shows the ongoing filling of wetland areas (Ref. 4, pp. 8 and 9). The 1973 aerial photograph indicates that all the wetlands and tributaries had been filled by the landfill (Ref. 4, pp. 16 and 17). Aerial photographs document that wastes disposed of in the landfill were deposited directly into wetlands, Darby Creek, and Cobbs Creek (Ref. 4, pp. 16 and 17a).

In 1982, an aqueous sample was collected from leachate that was observed to enter Darby Creek (Ref. 9, pp. 5 and 16). The leachate contained the following hazardous substances: aluminum (2,210 microgram per liter [µg/L]), cadmium (2.05 µg/L), chromium (30 µg/L), copper (120 µg/L), manganese (490 µg/L), nickel (30µg/L), lead (407.5 µg/L), and zinc (320 µg/L) (Ref. 9, p. 16).

Chemical Analysis

An observed release by chemical analysis is not evaluated in this Documentation Record or in the HRS scoring.

4.1.2.3 DRINKING WATER TARGETS

No drinking water targets have been identified within the TDL. The threat to drinking water targets was therefore not evaluated.

4.1.3.2 WASTE CHARACTERISTICS

The waste characteristics factor category for the threat to the human food chain is evaluated on the basis of the HWQ and the toxicity, persistence and bioaccumulation of hazardous substances available to migrate to surface water. Those factors and the waste characteristics factor category value for the threat to the human food chain are discussed below.

4.1.3.2.1 Toxicity/Persistence/Bioaccumulation

Hazardous substances known to be associated with the Clearview Landfill include organic and inorganic compounds. Toxicity, persistence, and bioaccumulation factor values for those hazardous substances are summarized in the table below and were obtained from the Superfund Chemical Data Matrix (ref. 2). Factor values for fresh water bodies were used.

TABLE 3
TOXICITY/PERSISTENCE/BIOACCUMULATION FACTOR VALUES

Hazardous Substance	Clear-view LF	Toxicity Factor Value	Persistence Factor Value	Food Chain Bioaccumulation Factor Value	Toxicity/ Persistence/ Bioaccumulation Factor Value	Ref.
Inorganic Compounds						
Aluminum	OR	- -[a]	1	--	--	2
Antimony	X	10,000	1	0.5	5,000	2
Arsenic	X	10,000	1	5	5×10^4	2
Barium	X	10,000	1	0.5	5,000	2
Cadmium	X/OR	10,000	1	5,000	5×10^7	2
Chromium	OR	10,000	1	5	5×10^4	2
Copper	X/OR	- -[a]	1	50,000	- -	2
Lead	X/OR	10,000	1	50	5×10^5	2
Manganese	OR	10,000	1	0.5	5,000	2
Mercury	X	10,000	0.4	50,000	2×10^8	2
Nickel	X/OR	10,000	1	0.5	5,000	2
Selenium	X	100	1	5,000	$5 \text{ X } 10^5$	2
Silver	X	100	1	50	5,000	2
Zinc	X/OR	10	1	500	5,000	2

Organic Compounds						
Acenaphthene	X	10	0.4	500	2,000	2
Anthracene	X	10	1	5,000	5×10^4	2
Benzo(a)anthracene	X	1,000	1	50,000	5×10^7	2
Benzo(a)pyrene	X	10,000	1	50,000	5×10^8	2
Benzo(b)fluoranthene	X	1,000	1	50,000	5×10^7	2
Benzo(g,h,i)perylene	X	- -[a]	1	50,000	- -	2
Benzo(k)fluoranthene	X	100	1	50,000	5×10^6	2
Butylbenzylphthalate	X	10	1	500	5,000	2
Carbazole	X	10	0.4	500	2,000	2
Chlorobenzene		100	0.0007	50	3.5	2
Chrysene	X	10	1	500	5,000	2
Fluoranthene	X	100	1	5,000	5×10^5	2
Fluorene	X	100	1	5,000	5×10^5	2
Indeno(1,2,3-cd)pyrene	X	1,000	1	50,000	5×10^8	2
2-Methylnaphthalene	X	- -[a]	0.4	5,000	- -	2
Naphthalene	X	100	0.4	500	2×10^4	2
Phenanthrene	X	- -[a]	1	50	- -	2
Pyrene	X	100	1	50	5,000	2
Pesticides/PCBs						
Aroclor-1248	X	10,000	1	50,000	5×10^8	2
Aroclor-1254	X	10,000	1	50,000	5×10^8	2
Aroclor-1260	X	10,000	1	50,000	5×10^8	2

Notes:

a No factor value provided in the Superfund Chemical Data Matrix.
X Indicates presence of substance in source.
OR Indicates presence of substance in observed release by direct obserivation.

Toxicity/Persistence/Bioaccumulation Factor Value: $5 \pi 10^8$

4.1.3.2.2 Hazardous Waste Quantity

The HWQ value assigned to the Clearview Landfill is provided below (see Section 2.4.2.1.5 of the HRS documentation record). The HWQ factor value for the surface water pathway was determined from HRS Table 2-6 (Ref. 1, p. 51591).

TABLE 4
HAZARDOUS WASTE QUANTITY VALUES - HUMAN FOOD CHAIN

Source Name	Source HWQ Value	Is Source Hazardous Waste Quantity Data Complete?
Clearview Landfill	832.76	No

HWQ Total = 832.76

The assigned HWQ factor value for the surface water migration pathway is 100 (Ref. 1, p. 51591, Table 2-6).

4.1.3.2.3 Waste Characteristics Factor Category Value

The waste characteristics factor category value is obtained by multiplying the highest toxicity and persistence factor value by the HWQ factor value, subject to a maximum value of 1×10^8 and multiplying this product by the bioaccumulation factor value, subject to a maximum value of 1×10^{12} (Ref. 1, p. 51620). The product is assigned a waste characteristics factor category value from HRS Table 2-7 (Ref. 1, p. 51592).

The highest toxicity, persistence, and bioaccumulation factor values assigned to the surface water migration pathway were for benzo(a)pyrene, indeno(1,2,3-cd)pyrene, Aroclor-1248, Aroclor-1254, and Aroclor-1260, which have a toxicity factor value of 10,000, a persistence factor value of 1, and a bioaccumulation factor value of 50,000 (Ref. 2).

Toxicity/Persistence (10,000) $\times$ HWQ factor value (100) = 1×10^6
Toxicity/Persistence/HWQ (1×10^6) $\times$ Bioaccumulation factor value (50,000) = 5×10^{10}
A waste characteristics factor category value of 320 was assigned from HRS Table 2-7 (Ref. 1, pp. 51620, 51592).

Hazardous Waste Quantity Assigned Value: 5×10^{10}
Waste Characteristics Category Value: 320

4.1.3.3 HUMAN FOOD CHAIN THREAT-TARGETS

A variety of hazardous substances, including organic and inorganic compounds that have a bioaccumulation factor value of 500 or more, are contained in the observed release(s) by direct observation. Darby Creek is used for recreational fishing (Ref. 80). Information indicates that Darby Creek is used as a fishery within the TDL and provides habitat for numerous fish species, including muskellunge, large- and small-mouth bass, striped bass, and catfish. In addition, Darby Creek is stocked with at least 10,000 trout each year (Ref. 80). The extent and level of contamination of the human food chain in Darby Creek is discussed below.

Actual Food Chain Contamination - Darby Creek

Cadmium, copper, and zinc have bioccumulation potential factor values of greater than 500 and were documented in the observed release by direct observation from the Clearview Landfill into Darby Creek, Section 4.1.2.1.1.

Closed Fishery

No closed fisheries have been documented within the TDL. A fish warning is posted at the John Heinz NWR; however, this does not constiute a closure. The reason for the posting is not related to any specific contamination (Ref. 80). The actual reason for posting has not been determined.

Benthic Tissue

No samples of benthic tissue have been identified from Darby Creek to document actual contamination of the human food chain.

Level I Concentrations

No level I concentrations have been documented in Darby Creek.

Sample ID: NA
Sample Medium: NA
Location: NA

Level II Fisheries

Section 4.1.2.1.1 documents an observed release by direct observation to Darby Creek of hazardous substances that have bioaccumulation factor values of 500 or more at the location of a human food chain fishery. Therefore, a Level II fishery in Darby Creek has been documented. The hazardous substances that meet the criteria for an observed release by direct observation, and that have bioaccumulation factor values of 500 or more, include cadmium, copper, and zinc.

4.1.3.3.1 Food Chain Individual

Observed releases of hazardous substances to Darby Creek from the Clearview Landfill have been documented by direct observation (see Section 4.1.2.1.1). Those hazardous substances present in observed releases that have bioaccumulation potential factor values of 500 or more are listed in Table SW-4. Darby Creek is used for recreational fishing (Ref. 80). Information indicates that Darby Creek is used as a fishery within the TDL and provides habitat for numerous fish species, including muskellunge, large- and small-mouth bass, striped bass, and catfish. In addition, Darby Creek is stocked with at least 10,000 trout each year (Ref. 80). The observed release by direct observation to Darby Creek of hazardous substances with a bioaccumulation factor value of 500 or more into a human food chain fishery, documents the presence of a Level II fishery in Darby Creek. A food chain individual factor value of 45 therefore was assigned as specified in HRS Section 4.1.3.3.1 (Ref. 1, p. 51620).

TABLE 5
HUMAN FOOD CHAIN INDIVIDUAL

Hazardous Substance	Observed Release by Direct Obs. Clearview Landfill	Surface Water	Bioaccumulation (Food Chain) Potential Factor Value	Reference
Cadmium	X	Darby Creek	5,000	2
Copper	X	Darby Creek	50,000	2
Zinc	X	Darby Creek	500	2

X = hazardous substance detected in observed release by direct observation for the source (see Section 4.1.2.1.1)

Food Chain Individual: 45

4.1.3.3.2 Population

4.1.3.3.2.1 Level I Concentrations

No samples have been identified documenting Level I contamination (Ref. 1, p. 51620).

Sum of Human Food Chain Population Values: 0

4.1.3.3.2.2 Level II Concentrations

Level II concentrations have been documented in the observed release to Darby Creek, and Darby Creek is used for recreational fishing. Darby Creek is stocked with trout upstream of the Lower Darby Creek Area (Ref. 80; Ref. 36, p. II-5). No data on pounds of fish or number of fish caught per year have been identified. The annual production in pounds for Darby Creek is therefore greater than zero.

TABLE 6
HUMAN FOOD CHAIN POPULATION VALUE

Identity of Fishery	Annual Production (pounds)	Reference	Human Food Chain Population Value
Darby Creek	>0	80	0.03

Sum of Human Food Chain Population Values: 0.03

4.1.3.3.2.3 Potential Human Food Chain Contamination

The surface water TDL for the Lower Darby Creek Area includes: Hermesprota Creek, Darby Creek, and the Delaware River. Fisheries within the TDL are subject to potential contamination of the human food chain. Fishery production data for those bodies of surface water are not complete or have not been identified. The inclusion of the potential human food chain contamination is expected to have a minimal affect on the site score. The value for the potential human food chain contamination therefore has not been scored.

Level I Concentration Factor Value: 0
Level II Concentration Factor Value: 0.03
Potential Contamination Factor Value: NS (not scored)

4.1.4.3 ENVIRONMENTAL THREAT TARGETS

The environmental threat is not evaluated for the Clearview Landfill. The environmental targets would only be evaluated as subject to potential contamination, and the resulting value would not affect the overall site score. However, an aerial photograph shows that the Clearview Landfill was situated on and surrounded by wetlands and a stream flows through the landfill along the eastern boundary (Ref. 4, pp. 6, 7, and 8). Aerial photographs from 1958 to 1973 show that these wetlands and the stream become landfilled (Ref. 4, pp. 6, 7 ,8, 9, 10, 11, 13, 14, 15, 16, and 17).

FINAL
HRS DOCUMENTATION RECORD

Site Name:	Lower Darby Creek Area/Folcroft Landfill and Annex
Contact Persons	
Site Contact:	Kristine Matzko, Remedial Project Manager U.S. Environmental Protection Agency (EPA) Region 3 (215) 814-5719
Documentation Record Contact:	Kevin Wood, NPL/HRS Coordinator EPA Region 3 (215) 814-3303

Pathways, Components, or Threats Not Scored

The Hazard Ranking System (HRS) evaluation performed for the Lower Darby Creek Area is focused exclusively on the surface water migration pathway. The ground water migration, soil exposure, and air migration pathways were not evaluated because their contribution to the overall score of the site is minimal.

FINAL
HRS DOCUMENTATION RECORD

Site Name: Lower Darby Creek Area/Folcroft Landfill and Annex

EPA Region: 3

Date Prepared: **January 3, 2000**
Revision I: **April 24, 2000**
Final: **April 16, 2001**

Street Address of Site: Calcon Hook Road (using Folcroft Landfill)

County and State: Delaware County, Pennsylvania

General Location in the State: Southeastern Pennsylvania (Figure 1)

Topographic Maps: U.S. Geologic Survey (USGS), Bridgeport, NJ-PA and Lansdowne, PA, 1967

Latitude: 39˚ 53˝ 08˝ N (Ref. 78)* Longitude: 75˚ 16˝ 04˝ W (Ref. 78)*

*The reference point is the end of the road on the John Heinz National Wildlife Refuge, on the Folcroft Landfill (see Reference 78).

WORKSHEET FOR COMPUTING HRS SITE SCORE

		S	S^2
1.	Ground Water Migration Pathway Score (S_{gw}) (from HRS Table 3-1, Line 13)	NS[a]	NS
2a.	Surface Water Overland/Flood Migration Component (from HRS Table 4-1, Line 30)	100	10,000
2b.	Ground Water to Surface Water Migration Component (from HRS Table 4-25, Line 28)	NS	NS
2c.	Surface Water Migration Pathway Score (S_{sw}) (Enter the larger of the two scores from Lines 2a and 2b as the pathway score).	100	10,000
3.	Soil Exposure Pathway Score (S_s) (from HRS Table 5-1, Line 22)	NS	NS
4.	Air Migration Pathway Score (S_a) (from HRS Table 6-1, Line 12)	NS	NS
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$		10,000
6.	**HRS Site Score** Divide the value on Line 5 by 4 and take the square root		50.00

Note:

[a] NS = Not scored

LOWER DARBY CREEK AREA
SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET

Factor Categories and Factors		Maximum Value	Value Assigned
Drinking Water Threat			
Likelihood of Release			
1. Observed Release		550	550
2. Potential to Release by Overland Flow			
2a. Containment	10		NS
2b. Runoff		25	NS
2c. Distance to Surface Water		25	NS
2d. Potential to Release by Overland Flow [lines 2a x (2b +2c)]		500	NS
3. Potential to Release by Flood			
3a. Containment (Flood)	10		NS
3b. Flood Frequency		50	NS
3c. Potential to Release by Flood [lines 3a x 3b]		500	NS
4. Potential to Release [lines 2d + 3c]		500	NS
5. Likelihood of Release [higher of lines 1 and 4]		550	NS
Waste Characteristics			
6. Toxicity/Persistence		a	NS
7. Hazardous Waste Quantity		a	NS
8. Waste Characteristics		100	NS
Targets			
9. Nearest Intake		50	NS
10. Population			
10a. Level I Concentrations		b	NS
10b. Level II Concentrations		b	NS
10c. Potential Contamination		b	NS
10d. Population [lines 10a + 10b + 10c]		b	NS
11. Resources		5	NS
12. Targets [lines 9 + 10d + 11]		b	NS
Drinking Water Threat Score			
13. Drinking Water Threat Score [lines 5 x 8 x 12)/82,500][c]		100	NS

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer

NS Not scored

**SURFACE WATER OVERLAND/FLOOD MIGRATION
COMPONENT SCORESHEET (Cont.)**

Factor Categories and Factors	Maximum Value	Value Assigned
Human Food Chain Threat		
Likelihood of Release		
14. Likelihood of Release [same value as line 5]	550	550
Waste Characteristics		
15. Toxicity/Persistence/Bioaccumulation	a	$5 \pi 10^8$
16. Hazardous Waste Quantity	a	100
17. Waste Characteristics	1,000	320
Targets		
18. Food Chain Individual	50	45
19. Population		
19a. Level I Concentrations	b	0
19b. Level II Concentrations	b	0.03
19c. Potential Contamination	b	NS
19d. Population [lines 19a + 19b + 19c]	b	0.03
20. Targets [lines 18 + 19d]	b	45.03
Human Food Chain Threat Score		
21. Human Food Chain Threat Score [lines 14 x 17 x 20)/82,500][c]	100	96.06

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer
NS Not Scored

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET (Cont.)

Factor Categories and Factors	Maximum Value	Value Assigned
Environmental Threat		
Likelihood of Release		
22. Likelihood of Release [same value as line 5]	550	550
Waste Characteristics		
23. Ecosystem Toxicity/Persistence/Bioaccumulation	a	$5_{\pi}10^{8}$
24. Hazardous Waste Quantity	a	100
25. Waste Characteristics	1,000	320
Targets		
26. Sensitive Environments		
26a. Level I Concentrations	b	0
26b. Level II Concentrations	b	375
26c. Potential Contamination	b	NS
27. Targets [lines 26a + 26b + 26c]	b	375
Environmental Threat Score		
28. Environmental Threat Score [lines 22 x 25 x 27)/82,500][c]	60	60
Surface Water Overland/Flood Migration Component Score for a Watershed		
29. Watershed Score [lines 13 + 21 + 28][c]	100	100
SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE		
30. Component Score (S_{of})[c] [highest score from line 29 for all watersheds evaluated][c]	100	100.00

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer
NS Not scored

1.0 INTRODUCTION

The Folcroft Landfill and Annex was permitted from approximately 1959 until 1974 to accept municipal, demolition, and hospital wastes. However, analysis of aerial photographs indicates that disposal activity took place as early as 1953 and that, by 1958, the landfill covered approximately two acres. Inspection reports prepared by PADER indicate that numerous permit violations occurred during operations (Ref. 31, p. 4). The Folcroft Landfill and Annex is located along the lower Darby Creek and John Heinz NWR. Darby Creek is considered a fishery at the Folcroft Landfill and Annex and for the entire TDL for the site. The John Heinz NWR is considered a sensitive environment and supports several a broad range of species. There is a release by direct observation from the landfill. Metals, PAHs and VOCs are some of the hazardous substances that have been associated with the landfill. See Figure 1 for location of the Folcroft Landfill and Annex. See Figure 1.

SOURCE DESCRIPTION

2.2 Source Characterization

HRS Source Type: Landfill

Source Description: Folcroft Landfill and Annex

The Folcroft Landfill and Annex was originally a private facility. It is now located within the 1,200-acre John Heinz NWR at Tinicum (formerly the Tinicum National Environmental Center). The refuge is located near the confluence of Darby Creek and the Delaware River (Figure 1). It was established by Congress in 1972 to preserve diverse fish and wildlife habitat for natural and educational purposes (Ref. 24, p. II-1; Ref. 49). In 1980, Congress authorized the U.S. Department of Interior (DOI) to purchase additional land to increase the size of the refuge. Included in that land acquisition was the 62-acre Folcroft Landfill and Annex (Ref. 36, p. I-1). More than 100,000 people visit the refuge to engage in hiking, bicycling, canoeing, fishing, bird watching, nature photography, environmental education, and other outdoor activities (Ref. 89).

The Folcroft Landfill is bordered by Darby Creek and Thoroughfare Creek on the east and southeast, Hermesprota Creek on the west, the closed Delaware County Incinerator and Delaware County Sewage Treatment plant on the north, and a tidal marsh on the southwest (Ref. 24, pp. II-3, III-1A; Ref 34). The annex is bordered by Hermesprota Creek on the east, a business park to the west, residential developments to the north, and the tidal marsh on the south (Ref. 34).

Folcroft Landfill and Annex are located at the highest elevation in the refuge. The landfill and annex are not inundated by the tidal fluctuations except for the base of the landfill where it borders the marsh and creeks. Folcroft Landfill slopes steeply along Darby Creek (on its east side) (Ref. 36, p. III-1).

In 1984, an aerial photography analysis of the Tinicum Marsh Environmental Center (now the John Heinz NWR) was completed for the period 1953 to 1983. Photographs taken during the years 1953, 1958, 1964, 1965, 1971, 1973, 1975, and 1983 were analyzed.

The 1953 aerial photograph of the Folcroft Landfill shows disposal activities beginning in a 0.25-acre area at the southern end of Calcon Hook Road. The landfill was located on the bank of a marsh. Waste disposal operations appeared to move southeastward into the marsh (Ref. 37, p. 22).

Between 1958 and 1971, the Folcroft Landfill was expanded to 47.5 acres (Ref. 37, p. 31). The Folcroft Landfill Annex (site 11) appears in the 1971 aerial photograph and was 16.5 acres in size (Ref. 37, p. 32). The 1975 aerial photographs indicate that disposal operations at the Folcroft Landfill and Annex had ceased (Ref. 37, p. 37).

The historical photographic analysis of the Folcroft Landfill indicates that dumping began there as early as 1953. However, the landfill did not open officially until 1959 (Ref. 36, p. IV-4; Ref. 37, pp. 22 and 23). Dumping continued at Folcroft Landfill until 47.5 acres of wetlands had been filled and the Folcroft Landfill abutted Darby Creek, Thoroughfare Creek (a branch of Darby Creek), and Hermesprota Creek. In addition, 16-½ acres of wetlands located at the Folcroft Annex were filled (Ref. 24, p. II-3; Ref. 37, p. 33). The two landfills operated under PADER Solid Waste Permit Number 10053 and were permitted to accept municipal, demolition, and hospital wastes. Inspection reports prepared by staff of PADER indicate that the landfills were not used solely for municipal dumping. In 1973, the landfills were closed for permit violations and improper management. Closure activities began in 1974 under orders to regrade the landfill, eliminate the excessively steep slopes, eliminate fires, and cover refuse with fill. Cover allegedly was obtained from dredge soils from the construction for Interstate 95, and the Sun Oil Company refinery in Marcus Hook, Pennsylvania (Ref. 24, p. II-3; Ref. 36, p. IV-4). Cover material averaged two to four feet thick, with depths in some locations ranging up to 10 feet. The area was seeded with rye and fescue grasses; but good vegetative cover was not established on the eastern half of the Folcroft Landfill. Site inspection reports for closure note the lack of vegetation (Ref. 36, p. IV-5).

The Folcroft Landfill was owned by Mr. Wilbur C. Henderson and Hauling. The landfill was used for approximately 13 years and was closed in 1974. The 11-acre landfill annex was owned by Henderson-Columbia Corporation. In 1980, DOI purchased seven acres of that property to become part of the 1,200-acre John Heinz NWR. The Philadelphia Electric Company purchased and currently owns the remaining four acres (Ref. 20, p. 2-1).

Investigations

Numerous investigations have been conducted at the Folcroft Landfill and Annex. The subsections presented below provide summaries of the findings of each of those investigations.

Periodic Inspections - 1969 and 1973

The earliest known visual inspection of the Folcroft Landfill was performed on August 28, 1969, before the annex began operating. According to the inspector, the landfill received wastes from the Philadelphia Navy Yard, the Boeing Vertical Company, and the American Viscose Company (Ref. 50, p. 1). Subsequent potentially responsible party (PRP) investigations identified those companies as PRPs (Ref. 23, pp. 13 to 15). During the inspection, oily sludge was being disposed of in an area south of the office building. Sewage sludge had been dumped on the east side of the landfill (Ref. 50, p. 1). On the west side of the landfill, refuse was being pushed directly into a swamp (Ref. 50, p. 2).

In 1970, a hydrogeological investigation of the landfill was conducted. According to the inspector, a loading dock located at the south end of a maintenance building extended to an inlet of Darby Creek. The inspector observed an oil-like material being discharged over the edge of the dock. Industrial wastes having an oily appearance were being disposed of on the surface of the landfill (Ref. 52, p. 1).

On the east side of the landfill refuse was being pushed into the water. Industrial waste consisting of oil-soaked fuller's earth and various green, lavender, white, and red materials were being placed directly in the marsh on the southeast corner of the landfill. An excavation, 30 x 20 feet in dimension, had been filled with black fluid to 4 feet below the surface of the ground. The inspector believed that the dark fluid was waste industrial oil (Ref. 52, p. 2). After the inspection, a notice of violation was issued to the owners of the landfill for placing industrial waste and refuse into waters of the Commonwealth without a valid permit (Ref. 51).

On October 5, 1972, a PADER inspection of the landfill was conducted. The inspector indicated that there was evidence of the dumping of liquids at the landfill (Ref. 53).

A PADER periodic inspection of the Folcroft Landfill was conducted on November 10, 1972. Hazardous liquid waste was found on the landfill. The inspector observed approximately 1,000 gallons of methyl-ethyl ketone (MEK) in 55-gallon drums. The drums were leaking, and the liquid was flowing toward Tinicum Marsh. Also located at the landfill were 20 unlabeled 55-gallon drums of liquids, sludges, and petroleum liquid and large amounts of barium oxide. All these wastes were reportedly located along the back edge of the landfill (probably the southwest section of the landfill). The inspectors noted a chemical odor and became nauseated (Ref. 22, p. 6.2-5).

On January 19, 1973, a second periodic inspection of the landfill by PADER was conducted. Several drums of assorted liquid wastes were found to have been deposited recently on the landfill (Ref. 22, p. 6.2-6) and sandblasting wastes were being used as clean fill in the landfill (Ref. 22, p. 6.2-8).

In May 1973 PADER collected samples from a ponded area, sludge, and a container observed on the landfill (Ref. 57 through 62). The analytical results from the analysis of the samples are provided in the table below.

TABLE 7
AQUEOUS AND WASTE SAMPLES COLLECTED FROM FOLCROFT LANDFILL - 1973

Sample Locations	Ponded Liquid Near Office	Liquid From Excavated Area	Ponded Liquid Adjacent to Access Road	Green Liquid From Can	Black Sludge on Current Work Area	Green Black Sludge on Old Work Area
Matrix	**Aqueous**	**Aqueous**	**Aqueous**	**Aqueous**	**Solid**	**Solid**
Sample Number	**679753**	**689754**	**689752**	**686505**	**686504**	**686503**
Inorganics (aqueous ug/L and solid mg/kg)						
Cadmium	NA	NA	NA	700	16	10
Copper	2,280	9,200	2,640	550	1,100	11,900
Chromium	340	920	320	1,050	580	187,000
Nickel	3,060	3,340	3,640	650	126	121
Zinc	9,000	79,000	5,200	138,000	22,700	131
Lead	6,700	13,600	440	177,000	1,200	150

Notes:Reference: 57 through 62
ug/LMicrogram per liter
NANot analyzed
mg/kgMilligram per kilogram

Site Inspection - 1980

EPA consultants completed an on-site inspection, and sampling of the Folcroft Landfill was conducted on October 29, 1980. One sample of hazardous material, four soil samples, and seven water samples were collected from the landfill (Ref. 22, pp. 2-1 and 5-2). The results of the analysis of the samples could not be located. Smoke or vapor was emanating from the landfill during the inspection (Ref. 22, pp. 7 and 2-1). Leachate was flowing directly into Thoroughfare Creek (a branch of Darby Creek) and Hermesprota Creek (Ref. 22, pp. 12 and 2-2). The following wastes were identified in the report as having been disposed of in the landfill: oil wastes; halogenated solvents; aromatic polar and nonpolar compounds; acids; pesticides; metals; fly ash; asbestos; radioactive materials; municipal waste; hospital; and

demolition waste (Ref. 22, pp. 4 of 10 and 6-1). It has not been determined how those wastes were identified.

Fire in Folcroft Landfill - 1983

On July 13, 1983, a grass fire occurred at the Folcroft Annex, allegedly caused by the catalytic converter of a vehicle parked over underbrush on the landfill. Eleven acres of the landfill burned (Ref. 44, p. 1). During the fire several drums were uncovered that contained a red, jelly-like substance that reacted with water (Ref. 44, p. 1; Ref. 24, p. II-3). During firefighting efforts, a number of those drums caught fire on contact with water (Ref. 44, p. 1). EPA Region 3 was notified and an immediate removal action was implemented (Ref. 44, pp. 1 and 2). Eight samples were taken from the drums and classified in terms of pH, flammability, reactivity, corrosivity, and pesticide content. Two samples from the drums were screened for metal content (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). Soil, sediment, water, and air samples also were taken and screened for 44 contaminants (Ref. 24, p. II-3). No concentrations of pollutants were detected in air samples above the allowable limits for workplaces established by the American Conference of Governmental Industrial Hygienists (Ref. 44, p. XII-13).

According to EPA pollution reports (POLREPS) filed during the removal action, the contents of two of the drums were not hazardous, and those drums were disposed in the landfill. Six of the drums were overpacked and disposed at a hazardous waste disposal facility (Ref. 44, p. X-3). A newspaper article about the fire indicates that the drums contained toluene, xylene, ethylbenzene, and lead (Ref. 44, p. XI-6). The contents of the drums are described in a hazardous waste manifest as follows: (1) resin-flammable solid, 170 gallons, waste code D001 (a solid waste that exhibits the characteristic of ignitability); (2) flammable solids - flammable solid, 85 gallons, waste code D001; (3) water-soluble lead - water soluble lead, 170 gallons, waste code D008 (lead concentration higher than 5.0 mg/L); and (4) asphalt - combustible solid, 85 gallons, waste code D001 (Ref. 45; Ref. 46, pp. 54 to 56).

A summary of the drum and soil samples collected during the removal action is provided in the table below.

TABLE 8
DRUM AND SOIL SAMPLES FROM FOLCROFT LANDFILL ANNEX - JULY 16 AND 18, 1983*

Sample ID	**2**	**3**	**7 and 8**	**9**	**S1**	**S2**
Sample Location	Drum	Drum	Drum	Drum	Soil	Soil
Inorganics (ppm)						
Arsenic	<.15	<.15	NA	NA	<.005	<.005
Barium	1.0	2.9	NA	NA	1.48	0.28
Cadmium	<.1	0.1	NA	NA	0.02	0.01
Chromium	0.15	0.6	NA	NA	0.09	0.01
Lead	3.1	12.3	NA	NA	0.53	3.08
Mercury	0.005	0.008	NA	NA	0.001	0.0015
Selenium	<.15	<.15	NA	NA	<.005	<.005
Silver	0.70	12.0	NA	NA	0.02	<.01
Organics (ppm)						
Naphthalene	<10	<10	<10	8,000	<10	<10
Acenaphthene	<10	<10	<10	3,870	<10	<10
Fluorene	<10	<10	<10	7,528	<10	<10

Sample ID	**2**	**3**	**7 and 8**	**9**	**S1**	**S2**
Sample Location	Drum	Drum	Drum	Drum	Soil	Soil
Phenanthrene	<10	<10	<10	8,000	<10	<10
Fluoranthene	<10	<10	<10	8,244	<10	<10
Pyrene	<10	<10	<10	12,713	<10	<10
Chrysene	<10	<10	<10	25,085	<10	<10
Benzofluoranthene	<10	<10	<10	11,794	<10	<10
Benzo(a)pyrene	<10	<10	<10	11,371	<10	<10
Indenopyrene	<10	<10	<10	2,512	<10	<10
Benzo(g,h,i) perylene	<10	<10	<10	1,636	<10	<10

Source:Reference 44, Section XII

* All compounds that are not listed were not detected: detection levels ranged from 10 to 100 ppm. All data are in ppm.

NA Not analyzed

ppm Parts per million

During firefighting activities, large quantities of illegally dumped hospital wastes were discovered throughout the surface of the landfill (Ref. 44, pp. 19 and X-4). EPA determined that the Folcroft Annex should be capped to adequately cover exposed surfaces, protecting the public health from direct contact with hospital wastes and drums (Ref. 44, p. 19). Six to eight inches of fly ash (filter cake), followed by 12 inches of compacted soil, were used to cap the landfill. The Philadelphia Electric Company supplied the fly ash, and its use was approved by PADEP (Ref. 44, pp. 3 and 6). The Philadelphia Electric Company provided to EPA analytical data that identified the contents of the filter cake (Ref. 47). By September 23, 1983, capping and hydroseeding of the entire landfill had been completed (Ref. 44, p. 25). Also during firefighting activities, the bulldozer used to cover smoldering underground fires exposed drums that had been buried near the surface of the landfill. Several of the drums burst into flames when their contents were exposed to the atmosphere (Ref. 44, p. X-4).

An Investigation of Potential Environmental Hazards - 1986

In 1980, Congress authorized DOI to purchase the 62-acre Folcroft Landfill and Annex to increase the size of the John Heinz NWR (formerly Tinicum National Environmental Center). Because it had been alleged that hazardous wastes had been dumped at the landfills, Congress directed EPA, in coordination and consultation with the U.S. Fish and Wildlife Service (FWS), DOI, to investigate potential environmental health hazards resulting from the Folcroft Landfill and to develop alternative recommendations about how such hazards, if any, might best be addressed to ensure the protection of the refuge and the general public (Ref. 36, p. I-1). *An Investigation of Potential Environmental Hazards at Tinicum National Environmental Center* (currently John Heinz NWR), was prepared to identify whether Folcroft Landfill and Annex posed an environmental threat to the refuge (Ref. 36, p. I-1).

The investigation identified the Folcroft Landfill as a source of aluminum, cyanide, copper, lead, and zinc at the John Heinz NWR (referred to as "the Center" in the report) (Ref. 36, p. *i* and IV-7). The leachate from the landfill was described as containing levels of copper (190 parts per billion [ppb]), lead (200 ppb), manganese (1,220 ppb), nickel (70 ppb), and zinc (1,090 ppb) that were determined to be toxic to laboratory organisms in bioassay tests (Ref. 36, pp. *i*, *ii* and p. IV-8, Table 6b). The report indicated that, in February 1986, EPA's Environmental Services Division collected and analyzed four samples from the Folcroft Landfill to screen for aquatic toxicity. (Ref. 36, p. IV-5). The investigation concluded that the Folcroft Landfill was a source of aluminum, cyanide, chromium, copper, and nickel contamination (chlordane also was identified; however, because that pesticide was in common use, that compound was not included in this discussion) (Ref. 36, pp. IV-16 and IV-28).

Site Inspection - 1988

In 1988, EPA and FWS conducted a joint site investigation as a follow-up to previous site investigations and sampling efforts that were conducted by EPA between October 1980 and February 1986. The site inspection included the collection of samples of soil, sediment, surface water and seeps, and ground water. The samples were analyzed for general physical and chemical parameters, Target Analyte List (TAL) metals, and Target Compound List (TCL) organic substances (Ref. 24, p. I-1). A discussion of the analytical results are presented in the sections below.

Surface Soil Analytical Results

Soil samples from Folcroft Landfill and Annex were collected and analyzed for general chemical parameters, TAL metals, and TCL organic compounds (Ref. 24, p. III-2). Figure 5 shows the locations from which the samples were collected. Eight of the nine samples of surface soil were composites of five grab samples collected within 100 feet of one another in a grid-type pattern. Surface soil sample ALS was a single-grab sample, rather than a composite. The composite samples were composited from a depth of 0 to 12 inches (Ref. 24, p. III-4). Table 9 provides a summary of substances detected at concentrations equal to or higher than three times the background level.

As Table 9 shows, the samples of surface soil collected from Folcroft Landfill and Annex document the presence of the following contaminants in surface soil at concentrations equal to or higher than three times the background level: acenaphthene; anthracene; benzo(a)anthracene; benzo(b)fluoranthene; benzo(k)fluoranthene; benzo(a)pyrene; benzo(g,h,i)perylene; chrysene; fluoranthene; dibenzofuran; fluorene; indeno(1,2,3-cd)pyrene; naphthalene; 2-methyl naphthalene; phenanthrene; pyrene; antimony; copper; lead; magnesium; mercury; selenium; silver; vanadium; and zinc.

Figure 5, 1988 Upland Surface Soil Sampling Locations for Folcroft Landfill and Annex.

Sample ID	Detection Limits	SSC	FOL-5	FOL-4	FOL-3	FOL-3	FOL-1	ANN-1	ANN-2	ALS	Reference
Organic Compounds (µg/kg)											
Chlorobenzene	6	ND	ND	ND	ND	ND	ND	ND	ND	**33**	24, pp. III-11, B-2
Naphthalene	390	ND	DB	DB	DB	ND	***7,900***	ND	***1300***	ND	24, pp. III-11, B-4
2-Methyl naphthalene	390	ND	DB	DB	DB	ND	***16,000***	ND	***1400***	ND	24, pp. III-11, B-4
Acenaphthene	390	ND	DB	DB	ND	ND	DB	DB	***1200***	ND	24, pp. III-11, B-4
Fluorene	390	ND	ND	DB	ND	ND	***2,300***	DB	***1600***	ND	24, pp. III-11, B-4
Phenanthrene	390	ND	DB	***2,400***	DB	DB	***12,000***	**520**	***10,000***	DB	24, pp. III-11, B-4
Anthracene	390	ND	ND	DB	DB	ND	DB	DB	***2,200***	ND	24, pp. III-11, B-4
Fluoranthene	390	ND	DB	***5,300***	DB	DB	***3,100***	***650***	***11,000***	DB	24, pp. III-11, B-4
Pyrene	390	ND	DB	***4,000***	DB	DB	***8,300***	***590***	***5,400***	DB	24, pp. III-11, B-4
Benzo(a)anthracene	390	ND	DB	***2,100***	ND	DB	***2,800***	DB	***3,600***	DB	24, pp. III-11, B-4
Chrysene	390	ND	DB	***2,500***	ND	DB	***3,100***	DB	***4,000***	DB	24, pp. III-11, B-4
Benzo(b)fluoranthene	390	ND	DB	***2,400***	ND	DB	DB	DB	***4,700***	DB	24, pp. III-11, B-4
Benzo(k)fluoranthene	390	ND	DB	***2,300***	ND	DB	DB	DB	***2,900***	DB	24, pp. III-11, B-4
Benzo(a)pyrene	390	ND	DB	***2,300***	ND	DB	DB	DB	***3,500***	DB	24, pp. III-11, B-4
Indeno (1,2,3-cd) pyrene	390	ND	ND	DB	ND	DB	DB	DB	***740***	ND	24, pp. III-11, B-4
Benzo(g,h,i)perylene	390	ND	DB	DB	DB	DB	DB	DB	***880***	ND	24, pp. III-11, B-4
dibenzofuran	390	ND	ND	DB	ND	DB	ND	ND	***1,500***	ND	24, pp. III-11, B-4
4,4'-DDE	118	ND	ND	ND	ND	***4,200***	ND	ND	ND	ND	24, pp. III-11, B-5
4,4'-DDT	118	ND	***240***	ND	***150***	ND	ND	ND	ND	ND	24, pp. III-11, B-5
Lindane	59	ND	DB	ND	ND	***1,030***	***61.3***	ND	DB	ND	24, pp. III-11, B-5

TABLE 9 (continued)
ORGANIC AND INORGANIC SUBSTANCES DETECTED IN SURFACE SOIL SAMPLES AT THE FOLCROFT LANDFILL AND ANNEX SITE INSPECTION 1988

Inorganic Compounds (mg/kg)											
Antimony	0.006	ND	***3.4***	***1.0***	***3.3***	***3.7***	***3.4***	***4.1***	***2.4***	NA	24, pp. B-2, B-6
Copper	0.010	30	***149***	***209***	***167***	***178***	84.3	***135***	36.3	NA	24, pp. B-2, B-6
Lead	0.002	62.5	***376***	***640***	***472***	***210***	***219***	132	33.0	NA	24, pp. B-2, B-6
Magnesium	0.010	1660	4630	3350	4380	3560	2700	***5,540***	4570	NA	24, pp. B-2, B-6
Mercury	0.0002	0.21	ND	0.6	***1.6***	***3.1***	***1.1***	ND	0.04	NA	24, pp. B-2, B-6
Selenium	0.003	ND	***2.9***	***2.8***	***4.0***	***3.7***	***1.7***	***2.5***	***1.7***	NA	24, pp. B-2, B-6
Silver	0.010	ND	ND	***2.5***	***12.5***	ND	***2.4***	ND	ND	NA	24, pp. B-2, B-6
Vanadium	0.010	14.3	41.0	38.8	40.2	32.3	***43.0***	***44.9***	***57.1***	NA	24, pp. B-2, B-6
Zinc	0.010	105	295	***882***	261	244	216	249	111	NA	24, pp. B-2, B-6

Notes: ***BOLD*** Concentration meets criteria for observed release, as set forth in Hazard Ranking System Table 2-3 (Ref. 1) (three times background concentration, or detection with a nondetect background), with consideration of data qualifiers (Ref. 33)
ALS Surface soil sample collected near leachate seep (Ref. 24, p. III-2)
ANN Folcroft Annex (Ref. 24, p. III-2)
DB Detected below the quantifiable limit
FOL Folcroft Landfill (Ref. 24, p. III-2)
ND None detected
SSC Control site, background (Ref. 24, p. II-2)
* These pesticides may be present as a result of routine application, therefore their presence is not attributed to waste disposed of in the landfill.

TABLE 9 (continued)
ORGANIC AND INORGANIC SUBSTANCES DETECTED IN SURFACE SOIL SAMPLES AT THE FOLCROFT LANDFILL AND ANNEX SITE INSPECTION 1988

Sampling Investigation - Lower Darby Creek Area - 1998

In May 1998, an investigation of the Lower Darby Creek Area was conducted to identify possible threats to human health and the environment posed by waste sources along lower Darby Creek, including the Folcroft Landfill and Annex (Ref. 31, pp. 1 and 16). During the investigation, several springs and seeps were observed on the southeastern edge of the Folcroft Landfill, along Thoroughfare Creek (a branch of Darby Creek). The edges and cover of the landfill showed erosion attributable to surface water runoff and tidal influences, with waste materials exposed. The extent of erosion was most significant along the more steeply sloped southern side, nearest to Thoroughfare Creek and the tidal marsh. Subsurface soil borings from the landfilled area of Folcroft Landfill Annex revealed fill material (Ref. 31, p. 6).

The sampling investigation included the collection of two waste samples (one soil sample and one leachate sample) from the Folcroft Landfill (Ref. 31, pp. 21 and 23). The following substances were detected in ground water samples: barium; cobalt; nickel; thallium; vinyl chloride; 1,1-dichloroethene; 1,2-dichloroethene; and chlorobenzene (Ref. 31, pp. 21, 23). The sample of solid waste revealed the presence of antimony, cadmium, lead, nickel, and silver at levels equal to or greater than three times the background concentrations (Ref. 31, Attachment 9, pp. 9-A-1 and 9-A-3). The sample identification for the waste sample was FLF/WS-43 (Ref. 31, p. 23).

Source Location (with reference to a map):

Folcroft Landfill and Annex is located in the 1,200-acre John Heinz NWR (formerly the Tinicum National Environmental Center) in the eastern section of Folcroft Borough, Delaware County (Ref. 31, p. 3) (Figure 1).

Containment:

Release to Ground Water: The ground water migration pathway was not evaluated.

Release via Overland Migration/Flood: As described below, there is evidence of the migration of hazardous substances from the Folcroft Landfill and Annex. Therefore, a surface water containment factor value of 10 was assigned (Ref. 1, p. 51609). Refuse and industrial waste from the landfill was pushed into an adjacent swamp (Ref. 50, p. 2; Ref. 52, p. 2). An oily material from the landfill was observed to be discharged into Darby Creek (Ref. 52, p. 1). Leachate from the landfill was observed to enter Darby Creek (Ref. 54; Ref. 55; Ref. 22, p. 12; Ref. 56, pp. 1 and 2; Ref. 36, p. IV-5). Waste disposal activities moved south into a marsh adjacent to the south side of the landfill (Ref. 37, p. 22).

Gas Release to Air: The air migration pathway was not evaluated.

Particulate Release to Air: The air migration pathway was not evaluated.

2.4.1 Hazardous Substances

No waste disposal records from the landfill are available. Observations made during on-site inspections indicate that the following types of wastes were disposed of in the landfill: industrial wastes; liquid wastes; MEK; drums of liquid; sludges; petroleum liquid; barium oxide; sandblasting wastes; lead; and hospital wastes (Ref. 52, pp. 1 and 2; Ref. 53; Ref. 22, pp. 6.2-5 and 6.2-8; Ref. 45; Ref. 46, pp. 54 to 56; and Ref. 44, pp. 19 and X-4). Hazardous substances detected in drum, waste, soil, and leachate samples collected from the landfill are summarized below.

TABLE 10
HAZARDOUS SUBSTANCES DETECTED IN SAMPLES
COLLECTED FROM THE FOLCROFT LANDFILL AND ANNEX

Hazardous Substance	Evidence	Reference
Organic Compounds		
Volatile Organic Compounds		
Chlorobenzene	Leachate sample	24, p. III-11
Semi-Volatile Organic Compounds		
Anthracene	Soil sample	24, p. III-11
Acenaphthene	Drum sample Soil sample	44, Section XII; 24, p. III-11
Benzo(a)anthracene	Drum sample Soil sample	44, Section XII; 24, p. III-11
Benzo(b)fluoranthene	Drum sample Soil samples	44, Section XII; 24, p. III-11
Benzo(k)fluoranthene	Drum sample Soil samples	44, Section XII; 24, p. III-11

TABLE 4 (continued)
HAZARDOUS SUBSTANCES DETECTED IN SAMPLES
COLLECTED FROM THE FOLCROFT LANDFILL AND ANNEX

Organic Compounds		
Benzo(a)pyrene	Drum sample Soil samples	44, Section XII; 24, p. III-11
Benzo(g,h,i)perylene	Soil sample	24, p. III-11
Chrysene	Drum sample Soil samples	44, Section XII; 24, p. III-11
Dibenzofuran	Soil sample	24, p. III-11
Fluoranthene	Drum sample Soil sample	44, Section XII; 24, p. III-11
Fluorene	Drum sample Soil sample	44, Section XII; 24, p. III-11
Indenopyrene	Drum sample	44, Section XII;
Naphthalene	Drum sample Soil sample	44, Section XII; 24, p. III-11
2-Methyl Naphthalene	Soil sample	24, p. III-11
Phenanthrene	Drum sample Soil sample	44, Section XII; 24, p. III-11
Pyrene	Drum sample Soil sample	44, Section XII; 24, p. III-11
Inorganic Compounds		

TABLE 4 (continued)
HAZARDOUS SUBSTANCES DETECTED IN SAMPLES
COLLECTED FROM THE FOLCROFT LANDFILL AND ANNEX

Organic Compounds		
Antimony	Soil sample	24, pp. B-2, B-6; See Table 9
Arsenic	Leachate	See Table 8
Barium	Drum sample Leachate sample	44, Section XII; See Table 8
Cadmium	Waste samples	60; 61; 62; 44, Section XII; See Tables 7 and 8
Copper	Leachate sample Waste samples Soil samples	54, pp. 1 and 2; 55, pp. 1 and 2; 57 through 62; 24, pp. B-2, B-6; See Tables 7 and 9
Chromium	Leachate sample Waste samples Drum sample	54, pp. 1 and 2; 55, pp. 1 and 2; See Tables 7 and 8; 57 through 62; 44, Section XII
Lead	Leachate Waste samples Drum samples Soil Samples	54, pp.1, 2 55, pp. 1, 2; 57 through 62; 44, Section XII; 24, pp. B-2, B-6; See Tables 7, 8, and 9
Magnesium	Soil sample	24, pp. B-2, B-6; See Table 9
Manganese	Leachate	See Table 9
Mercury	Drum samples Soil samples	44, Section XII; 24, pp B-2, B-6; See Tables 8 and 9
Nickel	Leachate sample Waste samples	54, pp. 1 and 2; 55, pp. 1 and 2; See Table 7; 57 through 62

TABLE 4 (continued)
HAZARDOUS SUBSTANCES DETECTED IN SAMPLES
COLLECTED FROM THE FOLCROFT LANDFILL AND ANNEX

Organic Compounds		
Selenium	Soil samples	24, pp. B-2, B-6; See Table 9
Silver	Drum samples Soil samples	44, Section XII; 24, pp. B-2, B-6; See Tables 8 and 9
Zinc	Leachate sample Waste samples Soil sample	54, pp. 1 and 2; 55, pp. 1 and 2; See Tables 7, 8, 10, 12; 57 through 62; 24, pp. B-2, B-6; See Table 9
Vanadium	Leachate sample soil samples	See Table 9; 24, pp. B-2, B-6

2.4.2 Hazardous Waste Quantity

2.4.2.1.1 Hazardous Constituent Quantity

The information available is insufficient to support evaluation of the hazardous constituent quantity for Folcroft Landfill and Annex.

Sum (pounds): Unknown
Hazardous Constituent Quantity Value: Not applicable (NA)

2.4.2.1.2 Hazardous Waste Stream Quantity

The information available is insufficient to support evaluation of the hazardous waste stream quantity for Folcroft Landfill and Annex.

Sum (pounds): Unknown
Hazardous Waste Stream Quantity Value: NA

2.4.2.1.3 Volume

The information available is insufficient to support evaluation of the volume for Folcroft Landfill and Annex.

Dimensions of the Source (yd^3): Unknown
Reference(s): NA
Volume Assigned Value: NA

2.4.2.1.4 Area

The area of the Folcroft Landfill and Annex was obtained by analysis of aerial photographs of the two landfills. The area of the two landfills is 64 acres (Ref. 37, pp. 31 and 32). The area of the landfills in ft^2 is: 64 acres π 43,560 ft^2/1 acre = 2,787,840 ft^2. The area divisor for determining the Hazardous Waste Quantity (HWQ) value assigned to a landfill is 3,400 (Ref. 1, p. 51591). The calculation of the HWQ value on the basis of the area of source is: 2,787,840/3,400 = 819.95

Area of Source (ft^2): 2,787,840
Reference(s): 48, pp. 31 and 32
Area Assigned Value: 819.95

2.4.2.1.5 Source Hazardous Waste Quantity Value

For Folcroft Landfill and Annex, the source HWQ value is based on an area of 64 acres (Ref. 36, p. I-1). The assigned value of the source is determined from HRS Table 2-5 (Ref. 1, p. 51591).

Source Hazardous Waste Quantity Value: 819.95

4.0 Surface Water Migration Pathway

4.1 Overland/Flood Migration Component

4.1.1.1 Definition of Hazardous Substance Migration Pathway for Overland Flow/Flood Component

Surface waters associated with the surface water migration pathway for the Folcroft Landfill and Annex include Darby Creek, Hermesprota Creek, Muckinipattis Creek, and Thoroughfare Creek, a branch of Darby Creek that flows along the eastern boundary of Folcroft Landfill. Thoroughfare Creek is sometimes referred to as Darby Creek. The surface water adjacent to the southern boundary of the Folcroft Landfill is referred to as both the Tidal Marsh and Darby Creek (Ref. 36, Figure following p. III-1). The farthest upstream segment of the surface water pathway is located at PPE-1, above the confluence of Hermesprota and Darby Creek. An enclosed area called the impoundment lies adjacent to the east side of Darby Creek in the area of Folcroft Landfill (Ref. 49). There are connections between Darby Creek and the impoundment (Ref. 36, p. III-3). Hermesprota Creek enters the study area from the north and flows along the western border of the former Delaware County Incinerator Landfill before channeling between the Folcroft Landfill and Annex; Hermesprota Creek ultimately discharges to Darby Creek in the John Heinz NWR (Ref. 34). Muckinipattis Creek flows south into Darby Creek, downstream of both the Folcroft Landfill and Annex and Hermesprota Creek at a point in the John Heinz NWR. After receiving discharge from the tributaries described above, Darby Creek empties into the Delaware River (Ref. 34; Ref. 5, p. 4; Ref. 20, p. 3-1) (Figure 6).

Darby Creek is tidally influenced upstream to the confluence of Darby Creek and Cobbs Creek (Ref. 24, p. II-5). Numerous private and public agencies have been contacted to determine more exactly the extent of tidal carry of Darby Creek; however, no data are available that document the extent of tidal carry in the creek. Therefore, the upstream target distance limit (TDL) was not evaluated. Additionally, no significant targets have been identified from the confluence of Cobbs Creek and Darby Creek. Areas upstream of the confluence of Cobbs Creek and Darby Creek are urbanized and developed and are not expected to provide significant habitat for threatened or endangered species identified under federal or state statute or other environmental targets (Ref. 34).

Figure 6, Location of Site and Surface Water Migration Pathway.

Folcroft Landfill and Annex - Overland Flow and PPE - Fol

During operation of the Folcroft Landfill and Annex, refuse and industrial waste from the landfill was pushed into an adjacent swamp (Ref. 50, p.2; Ref. 52, p. 2). In addition, an oily material was observed to discharge into Darby Creek (Ref. 52, p. 1). Leachate from the landfill also has been observed to enter Darby Creek (Ref. 54; Ref. 55; Ref. 22, p. 12; Ref. 56, pp. 1-2; Ref. 36, p. IV-5). Overland flow follows the topographic contours, and runoff enters Darby Creek, Hermesprota Creek, and the adjacent tidal marsh. Therefore, two PPEs are identified for this source: one located at the north end of the Folcroft Landfill Annex along Hermesprota Creek (PPE Fol-N), and one located on the east side of the Folcroft Landfill along Darby Creek (PPE Fol-E) (Ref. 36, p. III-3; Ref. 34). Figure 4 shows the PPE for Folcroft Landfill and Annex. The 15-mile TDL from Folcroft Landfill and Annex is described below and can be measured on Reference 34. In light of the past observations of disposal activities, the distance from the source to the PPEs is zero.

TABLE 11
FOLCROFT LANDFILL AND ANNEX - TARGET DISTANCE LIMIT

Segment	Description	Length (feet)	Mile/Feet Marker
PPE Fol-N			
1	From the PPE for Hermesprota Creek to the confluence with Darby Creek	5,280	1.0/5,280
2	From Darby Creek to the Delaware River	15,840	4.0/21,120
3	Remainder of the TDL in the Delaware River	58,080	15/79,200
PPE Fol-E			
1	From the PPE for Darby Creek to the Delaware River	21,120	4.0/21,120
2	Remainder of the TDL in the Delaware River	58,080	15/79,200

SD-Characterization and Containment
Source: Folcroft Landfill and Annex

Figure 7, PPEs for the Folcroft Landfill and Annex

4.1.2.1 LIKELIHOOD OF RELEASE

The surface-water migration pathway is evaluated against the criteria for an observed release of hazardous substances by direct observation.

4.1.2.1.1 Observed Release

Observed releases to Darby Creek and Hermesprota Creek have been documented by direct observation. A discussion of the documentation that supports observed releases to each of the surface-water bodies is provided in the section below.

Direct Observation

Observed releases by direct observation to Darby Creek from the Folcroft Landfill and Annex have been documented. Wastes disposed of in the Folcroft Landfill and Annex were deposited directly into wetlands and surface water. Leachate from the landfill was observed to flow directly to Darby Creek. The sections below document observed releases by direct observation from the Folcroft Landfill and Annex.

Direct Observation - Folcroft Landfill and Annex

During a PADER inspection of the landfill in 1969, refuse was observed to have been pushed into a swamp along the west side of the landfill (Ref. 50, p. 2). During a 1970 inspection, an oily material was observed to be discharged into an inlet of Darby Creek (Ref. 52, p. 1). Refuse on the east side of the landfill was being pushed into the water. Industrial waste consisting of oil-soaked Fuller's earth and material of various colors of green, lavender, white, and red was placed directly in the marsh on the southeast corner of the landfill (Ref. 52, p. 2). In response to the inspection, an NOV was issued to Folcroft Land Corporation (the owners of Folcroft Landfill and Annex) for placing industrial waste and refuse into waters of the Commonwealth without a valid permit (Ref. 51).

In October 1972, samples of leachate discharging into a marsh on the southern and western sides of the landfill were collected (Ref. 54 and 55). Because the leachate was observed to discharge on the southern and western sides of the landfill, the leachate would have been discharging into Hermesprota Creek and Darby Creek (see Figure 3). The table below summarizes the results of the chemical analysis of the leachate sample.

TABLE 12
1972 SUMMARY OF FOLCROFT LANDFILL LEACHATE ANALYTICAL RESULTS

Sample Locations Sample Number	Southwestern Side Landfill 682268	West Side Landfill 682267	Reference
Inorganic Substances (µg/L)			
Copper	30	150	54, pp. 1 and 2 55, pp. 1 and 2
Chromium	20	20	54, pp. 1 and 2 55, pp. 1 and 2
Nickel	90	0	54, pp. 1 and 2 55, pp. 1 and 2
Zinc	31	120	54, pp. 1 and 2 55, pp. 1 and 2
Lead	330	160	54, pp. 1 and 2 55, pp. 1 and 2

Based on the analytical results obtained from the leachate, copper, chromium, nickel, zinc, and lead were discharged directly into Hermesprota Creek and Darby Creek.

In December 1972, a leachate sample was collected from a leachate seep discharging into Tinicum Marsh (Darby Creek). The following inorganic contaminants were detected in the sample: copper (50 µg/L), chromium (40 µg/L), nickel (40 µg/L), zinc (440 µg/L), and cadmium (60 µg/L) (Ref. 56, pp. 1 and 2).

Leachate was observed to enter surface water from the Folcroft Landfill during numerous investigations (Ref. 22, pp. 12 and 2-2; Ref. 36, p. IV-5). During a 1986 investigation, numerous leachate seeps were observed flowing from the annex directly into the adjacent tidal flat. Seeps from the Folcroft Landfill were observed along the boundaries of the landfill adjacent to Hermesprota Creek and Thoroughfare Creek (Ref. 36, p. IV-5). Samples of those leachate seeps were not collected.

During a 1998 investigation a sample of leachate flowing into Darby Creek was collected (Ref. 31, p. 23). Analysis of the sample revealed the presence of arsenic, barium, chromium,manganese, nickel, and zinc (Ref. 31, p. 23; Ref. 83, Appendix D, p. 2, Appendix B, p. 1, and Appendix C, SDG MCSC48, p. 11).

Chemical Analysis

An observed release by chemical analysis is not evaluated in this Documentation Record or in the HRS scoring.

4.1.2.3 DRINKING WATER TARGETS

No drinking water targets have been identified within the TDL. The threat to drinking water targets was therefore not evaluated.

4.1.3.2 WASTE CHARACTERISTICS

The waste characteristics factor category for the threat to the human food chain is evaluated on the basis of the HWQ and the toxicity, persistence and bioaccumulation of hazardous substances available to migrate to surface water. Those factors and the waste characteristics factor category value for the threat to the human food chain are discussed below.

4.1.3.2.1 Toxicity/Persistence/Bioaccumulation

Hazardous substances known to be associated with the Folcroft Landfill and Annex evaluated at the Lower Darby Creek Area include organic and inorganic compounds. Toxicity, persistence, and bioaccumulation factor values for those hazardous substances are summarized in the table below and were obtained from the Superfund Chemical Data Matrix (ref. 2). Factor values for fresh water bodies were used.

TABLE 13
TOXICITY/PERSISTENCE/BIOACCUMULATION FACTOR VALUES

Hazardous Substance	Folcroft LF	Toxicity Factor Value	Persistence Factor Value	Food Chain Bioaccumulation Factor Value	Toxicity/ Persistence/ Bioaccumulation Factor Value	Ref.
Inorganic Compounds						
Antimony	X	10,000	1	0.5	5,000	2
Arsenic	X/OR	10,000	1	5	5×10^4	2
Barium	X/OR	10,000	1	0.5	5,000	2
Cadmium	X/OR	10,000	1	5,000	5×10^7	2
Chromium	X/OR	10,000	1	5	5×10^4	2
Copper	X/OR	- -[a]	1	50,000	- -	2
Lead	X/OR	10,000	1	50	5×10^5	2
Magnesium	X	- -[a]	1	0.5	- -	2
Mercury	X	10,000	0.4	50,000	2×10^8	2
Nickel	X/OR	10,000	1	0.5	5,000	2
Selenium	X	100	1	5,000	5×10^5	2
Silver	X	100	1	50	5,000	2
Vanadium	X	100	1	0.5	50	2
Zinc	X/OR	10	1	500	5,000	2

Organic Compounds						
Acenaphthene	X	10	0.4	500	2,000	2
Anthracene	X	10	1	5,000	5×10^4	2
Benzo(a)anthracene	X	1,000	1	50,000	5×10^7	2
Benzo(a)pyrene	X	10,000	1	50,000	5×10^8	2
Benzo(b)fluoranthene	X	1,000	1	50,000	5×10^7	2
Benzo(g,h,i)perylene	X	- -[a]	1	50,000	- -	2
Benzo(k)fluoranthene	X	100	1	50,000	5×10^6	2
Chlorobenzene	X	100	0.0007	50	3.5	2
Chrysene	X	10	1	500	5,000	2
Dibenzofuran	X	- -[a]	1	500	- -	2
Fluoranthene	X	100	1	5,000	5×10^5	2
Fluorene	X	100	1	5,000	5×10^5	2
Indeno(1,2,3-cd)pyrene	X	1,000	1	50,000	5×10^8	2
2-Methylnaphthalene	X	- -[a]	0.4	5,000	- -	2
Naphthalene	X	100	0.4	500	2×10^4	2
Phenanthrene	X	- -[a]	1	50	- -	2
Pyrene	X	100	1	50	5,000	2

Notes:

a No factor value provided in the Superfund Chemical Data Matrix.
X Indicates presence of substance in source.
OR Indicates presence of substance in observed release by direct obserivation.

Toxicity/Persistence/Bioaccumulation Factor Value: $5 \pi 10^8$

4.1.3.2.2 Hazardous Waste Quantity

HWQ value assigned to the Folcroft Landfill and Annex is given below (see Section 2.4.2.1.5 of the HRS documentation record). The HWQ factor value for the surface water pathway was determined from HRS Table 2-6 (Ref. 1, p. 51591).

TABLE 14
HAZARDOUS WASTE QUANTITY VALUES - FOOD CHAIN

Source Name	Source HWQ Value	Is Source Hazardous Waste Quantity Data Complete?
Folcroft Landfill and Annex	819.95	No

HWQ Total = 819.95

The assigned HWQ factor value for the surface water migration pathway is 100 (Ref. 1, p. 51591, Table 2-6).

4.1.3.2.3 Waste Characteristics Factor Category Value

The waste characteristics factor category value is obtained by multiplying the highest toxicity and persistence factor value by the HWQ factor value, subject to a maximum value of 1×10^8 and multiplying this product by the bioaccumulation factor value, subject to a maximum value of 1×10^{12} (Ref. 1, p. 51620). The product is assigned a waste characteristics factor category value form HRS Table 2-7 (Ref. 1, p. 51592).

The highest toxicity, persistence, and bioaccumulation factor values assigned to the surface water migration pathway were for benzo(a)pyrene and indeno(1,2,3-cd)pyrene which have a toxicity factor value of 10,000, a persistence factor value of 1, and a bioaccumulation factor value of 50,000 (Ref. 2).

Toxicity/Persistence (10,000) $\times$ HWQ factor value (100) = 1×10^6
Toxicity/Persistence/HWQ (1×10^6) $\times$ Bioaccumulation factor value (50,000) = 5×10^{10}
A waste characteristics factor category value of 320 was assigned from HRS Table 2-7 (Ref. 1, p. 51592).

Hazardous Waste Quantity Assigned Value: 5×10^{10}
Waste Characteristics Category Value: 320

4.1.3.3 HUMAN FOOD CHAIN THREAT-TARGETS

A variety of hazardous substances, including organic and inorganic compounds that have a bioaccumulation factor value of 500 or more, are contained in the observed release(s) by direct observation. Darby Creek is used for recreational fishing (Ref. 80). Information indicates that Darby Creek is used as a fishery in the John Heinz NWR and provides habitat for numerous fish species, including muskellunge, large- and small-mouth bass, striped bass, and catfish. Darby Creek and the surrounding John Heinz NWR also provide habitat for migrating birds and waterfowl (Ref. 36, p. III-14; Ref. 24, p. II-6). The extent and level of contamination of the human food chain in Darby Creek is discussed below.

Actual Food Chain Contamination - Darby Creek

Cadmium, copper, and zinc have bioaccumulation potential factor value of greater than 500 and were documented in the observed release by direct observation for the Folcroft Landfill and Annex into Darby Creek (Section 4.1.2.1.1).

Closed Fishery

No closed fisheries have been documented within the TDL. A fish warning is posted at the John Heinz NWR; however, the reason for the posting is not related to any specific contamination (Ref. 80). The actual reason for posting has not been determined.

Benthic Tissue

No samples of benthic tissue have been collected from Darby Creek to document actual contamination of the human food chain.

Level I Concentrations

No level I concentrations have been documented in Darby Creek.

Sample ID: NA
Sample Medium: NA
Location: NA

Level II Fisheries

Section 4.1.2.1.1 documents an observed release by direct observation to Darby Creek of hazardous substances that have bioaccumulation factor values of 500 or more into a human food chain fishery. Therefore, a Level II fishery in Darby Creek has been documented. The hazardous substances that meet the criteria for an observed release by direct observation, and that have bioaccumulation factor values of 500 or more, include cadmium, copper, and zinc.

4.1.3.3.1 Food Chain Individual

Observed releases of hazardous substances to Darby Creek from the Folcroft Landfill and Annex have been documented by direct observation (see Section 4.1.2.1.1). Those hazardous substances present in

observed releases that have bioaccumulation potential factor values of 500 or more are listed in Table SW-5. Darby Creek is used for recreational fishing (Ref. 80). Information indicates that Darby Creek is used as a fishery in the John Heinz NWR and provides habitat for numerous fish species, including muskellunge, large- and small-mouth bass, striped bass, and catfish. The observed release by direct observation to Darby Creek of hazardous substances with a bioaccumulation factor value of 500 or more into a human food chain fishery documents the presence of a Level II fishery in Darby Creek. A food chain individual factor value of 45 therefore was assigned as specified in HRS Section 4.1.3.3.1 (Ref. 1, p. 51620).

TABLE 15
HUMAN FOOD CHAIN INDIVIDUAL

Hazardous Substance	Observed Release Folcroft Landfill & Annex	Surface Water	Bioaccumulation (Food Chain) Potential Factor Value	Reference
Cadmium	X	Darby Creek	5,000	2
Copper	X	Darby Creek	50,000	2
Zinc	X	Darby Creek	500	2

X = hazardous substance detected in observed release by direct observation for the source (see Section 4.1.2.1.1)

Food Chain Individual: 45

4.1.3.3.2 Population

4.1.3.3.2.1 Level I Concentrations

Because the observed release is documented by direct observation only and not chemical analysis, there are no Level I concentrations (Ref. 1, p. 51620).

Sum of Human Food Chain Population Values: 0

4.1.3.3.2.2 Level II Concentrations

Level II concentrations have been documented in the observed release by direct observation to Darby Creek. Darby Creek is used for recreational fishing at the point of the observed release by direct observation (Ref. 80; Ref. 36, p. II-5). No data on pounds of fish or number of fish caught per year have been identified, but fishing is known to occur. The annual production in pounds for Darby Creek is therefore greater than zero.

TABLE 16
HUMAN FOOD CHAIN POPULATION VALUE

Identity of Fishery	Annual Production (pounds)	Reference	Human Food Chain Population Value
Darby Creek	>0	80	0.03

Sum of Human Food Chain Population Values: 0.03

4.1.3.3.2.3 Potential Human Food Chain Contamination

The surface water TDL for the Lower Darby Creek Area includes: Hermesprota Creek, Darby Creek, and the Delaware River. Fisheries within the TDL are subject to potential contamination. Fishery production data for those bodies of surface water are not complete or have not been identified. The inclusion of the potential human food chain contamination is expected to have a minimal affect on the site score. The value for the potential human food chain contamination therefore has not been scored.

Level I Concentration Factor Value: 0
Level II Concentration Factor Value: 0.03
Potential Contamination Factor Value: NS (not scored)

4.1.4.2 WASTE CHARACTERISTICS

The waste characteristics factor category for the environmental threat is evaluated on the basis of the HWQ and the ecosystem toxicity, persistence and bioaccumulation of hazardous substances available to migrate to surface water. Those factors and the waste characteristics factor category value for the environmental threat are discussed below.

4.1.4.2.1 Ecosystem Toxicity/Persistence/Bioaccumulation

Hazardous substances known to be associated with the Folcroft Landfill and Annex include organic and inorganic compounds. Ecosystem toxicity and persistence factor values for those hazardous substances are summarized in the table below and were obtained from the SCDM (Ref. 2). The ecosystem toxicity and persistence factor values for fresh water were used.

TABLE 17
ECOSYSTEM TOXICITY/PERSISTENCE

Hazardous Substance	Folcroft Landfill & Annex	Ecosystem Toxicity Factor Value	Persistence Factor Value	EcoToxicity/ Persistence Factor Value	Ref.
Inorganic Compounds					
Antimony	X	100	1	100	2
Arsenic	X/OR	10	1	10	2
Barium	X/OR	1	1	1	2
Cadmium	X/OR	1,000	1	1,000	2
Chromium	X/OR	100	1	100	2
Copper	X/OR	100	1	100	2
Lead	X/OR	1,000	1	1,000	2
Magnesium	X	--[a]	1	--	2
Mercury	X	10,000	0.4	4,000	2
Nickel	X/OR	10	1	10	2
Selenium	X	1,000	1	1,000	2
Silver	X	10,000	1	10,000	2
Vanadium	X	--[a]	1	--	2
Zinc	X/OR	10	1	10	2

Organic Compounds					
Anthracene	X	10,000	1	10,000	2
Benzo(a)anthracene	X	10,000	1	10,000	2
Benzo(a)pyrene	X	10,000	1	10,000	2
Benzo(b)fluoranthene	X	--[a]	1	--	2
Benzo(g,h,i)perylene	X	--[a]	1	--	2
Benzo(k)fluoranthene	X	--[a]	1	--	2
Chlorobenzene	X	1,000	0.0007	0.7	2
Chrysene	X	1,000	1	1,000	2
Dibenzofuran	X	100	1	100	2
Fluoranthene	X	10,000	1	10,000	2
Fluorene	X	1,000	1	1,000	2
Indeno(1,2,3-cd)pyrene	X	--[a]	1	--	2
2-Methylnaphthalene	X	1,000	0.4	400	2
Naphthalene	X	1,000	0.4	400	2
Phenanthrene	X	1,000	1	1,000	2
Pyrene	X	10,000	1	10,000	2

Notes:

a No factor value provided in the SCDM.
X Indicates presence of substance in source.
OR Indicates presence of substance in observed release by direct observation.

EcoToxicity/Persistence Factor Value: 10,000

4.1.4.2.1 Ecosystem Toxicity/Persistence/Bioaccumulation

Hazardous substances known to be associated with the Folcroft Landfill and Annex include organic and inorganic compounds. Toxicity, persistence, and bioaccumulation factor values for those hazardous substances are summarized in the table below and were obtained from the SCDM (Ref. 2).

TABLE 18
ECOSYSTEM TOXICITY/PERSISTENCE/BIOACCUMULATION

Hazardous Substance	Folcroft Landfill & Annex	Ecosystem Toxicity/ Persistence Factor Value (Ref. 1, Table 4-20)	Ecosystem Bioaccumulation Factor Value (HRS Section 4.1.3.2.1.3)	Ecosystem Toxicity/ Persistence/ Bioaccumulation Factor Value (HRS Table 4-21)	Ref.
Inorganic Compounds					
Antimony	X	100	5	500	2
Arsenic	X/OR	10	500	5,000	2
Barium	X/OR	1	0.5	0.5	2
Cadmium	X/OR	1,000	5,000	5×10^6	2
Chromium	X/OR	100	5	500	2
Copper	X/OR	100	50,000	5×10^6	2
Lead	X/OR	1,000	5,000	5×10^6	2
Magnesium	X	--[a]	0.5	--	2
Mercury	X	4,000	50,000	2×10^8	2
Nickel	X/OR	10	500	5,000	2
Selenium	X	1,000	5,000	5×10^6	2
Silver	X	10,000	50	5×10^5	2
Vanadium	X	--[a]	0.5	--	2
Zinc	X/OR		500	5,000	2

TABLE 18 (CONTINUED)
ECOSYSTEM TOXICITY/PERSISTENCE/BIOACCUMULATION

Organic Compounds					
Anthracene	X	10,000	5,000	5×10^7	2
Benzo(a)anthracene	X	10,000	50,000	5×10^8	2
Benzo(a)pyrene	X	10,000	50,000	5×10^8	2
Benzo(b)fluoranthene	X	–[a]	50,000	--	2
Benzo(g,h,i)perylene	X	–[a]	50,000	--	2
Benzo(k)fluoranthene	X	–[a]	50,000	--	2
Chlorobenzene	X	0.7	50	35	2
Chrysene	X	1,000	5,000	5×10^6	2
Dibenzofuran	X	100	500	5×10^4	2
Fluoranthene	X	10,000	500	5×10^6	2
Fluorene	X	1,000	5,000	5×10^6	2
Indeno(1,2,3-cd)pyrene	X	–[a]	50,000	--	2
2-Methylnaphthalene	X	400	5,000	2×10^6	2
Naphthalene	X	400	500	2×10^5	2
Phenanthrene	X	1,000	5,000	5×10^6	2
Pyrene	X	10,000	50	5×10^5	2

Notes: a No factor value provided in the SCDM.
X Indicates presence of substance in source.
OR Indicates presence of substance in observed release.

Ecosystem Toxicity/Persistence/Bioaccumulation Factor Value: $5 \pi 10^8$

4.1.4.2.2 Hazardous Waste Quantity

HWQ value assigned to the Folcroft Landfill and Annex is given below (see Section 2.4.2.1.5 of the HRS documentation record). The HWQ factor value for the surface water pathway was determined from HRS Table 2-6 (Ref. 1, p. 51591).

TABLE 19
HAZARDOUS WASTE QUANTITY VALUES - ENVIRONMENTAL THREAT

Source Name	Source HWQ Value	Is Source Hazardous Waste Quantity Data Complete?
Folcroft Landfill and Annex	819.95	No

HWQ Total = 819.95

The assigned HWQ factor value for the surface water migration pathway is 100 (Ref. 1, p. 51591, Table 2-6).

4.1.4.2.3 Waste Characteristics Factor Category Value

The waste characteristics factor category value is obtained by multiplying the highest ecosystem toxicity and persistence factor value by the HWQ factor value, subject to a maximum value of 1×10^8 and multiplying this product by the bioaccumulation factor value, subject to a maximum value of 1×10^{12} (Ref. 1, p. 51624). The product is assigned a waste characteristics factor category value from HRS Table 2-7 (Ref. 1, p. 51592). The highest ecosystem toxicity, persistence, and bioaccumulation factor values assigned to the surface water migration pathway were for benzo(a)anthracene and benzo(a)pyrene which have an ecosystem toxicity factor value of 10,000, a persistence factor value of 1, and a bioaccumulation factor value of 50,000 (Ref. 2).

Ecosystem Toxicity/Persistence (10,000) $\times$ HWQ factor value (100) $= 1 \times 10^6$
Ecosystem Toxicity/Persistence/ HWQ factor value (1×10^6) $\times$ Bioaccumulation factor value of 50,000 = 5×10^{10}
A waste characteristics factor category value of 320 was assigned from HRS Table 2-7 (Ref. 1, pp. 51592, 51624).

Hazardous Waste Quantity Assigned Value: 5×10^{10}
Waste Characteristics Category Value: 320

4.1.4.3 ENVIRONMENTAL THREAT - TARGETS

The surface water migration pathways for the Folcroft Landfill and Annex encompass the John Heniz National Wildlife Refuge, wetlands, and other sensitive environments.

Level I Concentrations:

Because the observed release is documented by direct observation and not chemical analysis, there can be no Level I concentrations.

Level II Concentrations:

Because there is an observed release by direct observation, Level II concentrations of sensitive environments in Darby Creek have been documented.

4.1.4.3.1 Sensitive Environments

The Folcroft Landfill and Annex site includes a portion of the 1,200 acre John Heinz NWR at Tinicum (formerly the Tinicum National Environmental Center) which is the largest freshwater tidal marsh in Pennsylvania. The refuge includes 350 acres of tidal marsh. The refuge is located near the confluence of Darby Creek and the Delaware River. It was established by Congress in 1972 to preserve diverse fish and wildlife habitat for natural and educational purposes. In 1998, over 100,000 people visited John Heinz NWR to engage in hiking, bicycling, canoeing, fishing, bird watching, nature photography, environmental education, and other outdoor related activities (Ref. 89; Ref. 24, p. II-1).

The diversity of habitat at the refuge provides the food, cover, and nesting requirements for a variety of wildlife. The tidal marsh is characterized by zones of wetland plants such as wild rice, spatter-dock, cattail, and countless combinations of associated plant species (Ref. 24, p. II-6). The values of this wetland type to birds are magnified in the case of the refuge marshes because of their strategic location on the Atlantic Flyway. Delaware Bay represents a major interchange on the Atlantic Flyway. The refuge is used intensely by migrating birds for food and protection. Over 280 species of birds have been observed in the refuge (Ref. 36, p. III-14). The 145-acre impoundment east of the Folcroft Landfill attracts wintering waterfowl and is home to numerous other bird, reptile, amphibian, and fish species. A heron rookery is on a brushy island habitat within the 145-acre impoundment. In addition, three plant species listed as "proposed rare" by the Commonwealth of Pennsylvania occur in the refuge (Ref. 24, p. II-6). They include: river bulrush (Scirpus fluviatilis), Indian wild rice (Zizania aqauatica), and waterhemp ragweed (Amaranthus cannabinus). Wright's spike-rush (Elecharis obtusa), a Pennsylvania "tentatively undermined" species, has also been observed at the refuge (Ref. 36, p. III-10).

Over 40 species of fish have been documented at the refuge, including anadromous and catadromous species such as the American shad, white perch, blueback herring, alewife, gizzard shad, and American eel. Almost 30 species of amphibians and reptiles have been reported at the refuge, including several listed rare or threatened by the Commonwealth of Pennsylvania. The large snapping turtles that inhabit the refuge have been harvested commercially in the past. Over 280 species of birds have been reported to use the varied habitats present at the refuge. Nine species of waterfowl nest in the refuge. In addition, six bird species nesting at the refuge that have been identified as "Species of Special Emphasis" by the FWS are the wood duck, black duck, American woodcock, snowy egret, black-crowned night heron, and great egret (Reg. 24, p. II-6; Ref. 36, pp. III-18 to III-20). Darby Creek and the surrounding John Heinz NWR provide habitat for migrating birds and waterfowl (Ref. 36, p. III-14; Ref. 24, p. II-6).

Darby Creek, Cobbs Creek, Muckinipattis Creek, Thoroughfare Creek, and Hermesprota Creek are the major streams that form the refuge watershed (Ref. 24, p. II-5). The PADER designated protected water use for these five streams. These uses are Warm Water Fishery, industrial water supply, live-stock water supply, wildlife water supply, irrigation, boating, fishing, water contact sports, and aesthetics (Ref. 36, p. III-1).

The habitat of the above species would include the wetlands along the observed release by direct observation.

4.1.4.3.1.1 Level I Concentrations

Because the observed release is documented only by direct observation and not chemical analysis, there can be no Level I concentrations.

Level I Concentrations Factor Value: 0

4.1.4.3.1.2 Level II Concentrations

Sensitive Environments

TABLE 20
LEVEL II SENSITIVE ENVIRONMENTS

Sensitive Environment	Distance from PPE from Folcroft Landfill and Annex to Nearest Sensitive Environment	Reference	Value(s)
John Heinz NWR at Tinicum	0	49	75
Red-bellied turtle-habitat	0	49	75
Southern leopard frog-habitat	0	49	75
American bittern-habitat	0	81	50
Least bittern-habitat	0	81	50
Great egret-habitat	0	81	50

Sum of Sensitive Environments Value: 375

Wetlands

Level II wetlands are not evaluated because the minimum wetlands frontage to receive consideration is 0.1 mile in the HRS scoring(Ref. 1, Table 4-24 pp. 51625). The observed release by direct observation is not expected to document this minimum frontage distance.

Total Wetlands Frontage: 0
Wetlands Value: 0

Sum of Sensitive Environments Value + Wetlands Value: 375

Level II Concentrations Factor Value: 375